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DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

EDITED BY A. S. RUSSELL, M.C., D.Sc.

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CONTENTS

EDITORIAL NOTES		355
THE EMS TELEGRAM AND THE FRANCO-GERMAN WAR.	Prof. A. J. Grant	358
THE STRUCTURE OF THE ATOM	Dr. A. S. Russell.	361
LEGAL MINIMUM WAGES	Prof. Douglas Knoop	364
TEMPORARY STARS	Donald W. Horner	368
THE HIEROGLYPHS OF CENTRAL AMERICA	Lewis Spence.	369
OCEAN CURRENTS	P. J. Harwood	374
REVIEWS OF BOOKS		377

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DISCOVERY. A Monthly Popular Journal of Knowledge.

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Editorial Notes

THE continued success of DISCOVERY has naturally attracted a number of suggestions for its improvement. Among the wants most strongly felt has been the need for fuller illustration, especially of the scientific articles. This is impossible without a change from the paper hitherto employed to one which will receive photographic reprints; and, of course, both this and the illustrations themselves will add much to the expense of production, which already, through the present rise in the cost of printing, has gravely exceeded the estimates. After careful consideration, the Committee has decided to provide more illustration, trusting that the generous support hitherto accorded to DISCOVERY will not be diminished by the consequent increase in price stated above, which is more than justified by the increase in the cost of production.

* * * * *

With this number we complete the first year of our life. It has been an interesting year full of the surprises, adventures, and new beginnings that serve to make life, even at its worst, a much greater and finer thing than mere existence. In politics, in industry, and in the intellectual world, we are beginning to realise that the war is really over, and that hope and progress lie not in dwelling on the past, but in working in the present and planning for the future. This year has witnessed the first signs of resumed co-operation in intellectual work between ourselves and our late enemies; and although we must always respect and refrain from criticising the attitude of those who cannot see their way at present to resume the old friendly, co-operative spirit of the past, yet one may rejoice that many at least realise, and among them some who were not the least zealous in the fight, that the sooner we get back to the old attitude of mutual regard and understanding with those who wish it, the speedier will be the solution of those problems of science, of letters, and of life, on which the future of humanity so largely depends.

* * * * *

Two of the outstanding subjects of interest in the intellectual world have been the New Psychology and the theory of Relativity. Books, lectures, and discussions on these subjects have been popular everywhere, and when able men have lectured upon them, long queues of men and women have waited patiently for admission to the lecture-room. Aviation, in spite of the excellent and hopeful Air Conference in October, seems to have suffered a set-back. The climate, lack of generous endowment, and impatience seem to be contributory causes of this. A new star was discovered in the heavens in August. Mr. Wells's *Outline of History* has been completed and published, and the great biography of Disraeli commenced by W. F. Monypenny has been successfully finished by Mr. Buckle.

* * * * *

These are but a few of the events of the year which concern us. Progress in all the chief departments into which intellectual matters in this country are divided seems good. It is sad to have to record that elsewhere things are different. Many eyes during the year have turned towards Vienna, a city that has for centuries been an outpost of light and learning towards the East, and which now seems to be falling into ruin and decay because of a lack of the necessities of life. What a splendid city was Vienna before the war! Brightness and mirth were in her streets. One remembers little things like the cream in the cups of coffee sold in her cafés, so thick that a lump of sugar

carefully placed on top took fifteen seconds to sink into the coffee below. But the things that mattered: her University and institutes of learning, her men and women, all the beauty and the wonder and the power, then so high and great, and now—what a contrast!

* * * * *

It almost passes belief. We have been accustomed to see red when we think of Austria, and all the muck and misery into which the war she started has plunged us and herself: but when we reflect upon her present misery, the lack of an adequate supply of food, of clothing, and of fuel, which most of her inhabitants are experiencing; her students, professors, and investigators, famous in time past for their learning and their discoveries, now with barely enough, many of them, to keep body and soul together; without the means of buying books or of getting the necessary apparatus, *in some cases dying of starvation*; we feel that the advancement of learning is not yet so great and general a thing that the world without loss can let even one of its cities go down-hill. We rejoice that so many generous spirits have come forward with real offers of help and service, and we pray that they and others may have the power and means to save Vienna even yet from a fate which appears inevitable.

* * * * *

To turn to another matter.

There is a certain class of books against which, it seems to us, protest with some vigour should be directed, because we believe they are in their tone against the advancement of the subject with which they deal and of the esteem in which it is held, and in their facts ill-informed, misleading, and erroneous. The books we refer to are those in which a rough hash of truths, heresies, and misstatements concerning present-day science is used to set-off and make topical and interesting the theories and ideas of their authors upon the particular subject which interests them. No one minds very much—although, personally, we think people should mind a good deal more than they do—how wild and wonderful a man may be in his ideas and theories. They are interesting to somebody; interesting psychologically, for example, if in no other way. But when a book is published in which the patient work and ascertained results of investigators in such subjects as history, anthropology, biology, or chemistry are gently thrust aside merely because they interfere in some way with the particular bee in the author's bonnet, it seems high time for a protest to be made.

* * * * *

The book[1] before us, which we have selected to illustrate our point (which we hope is a sound one, and not just a bee in our own bonnet), is not a particularly bad example of the class, but that it could be written as it has been by a doctor, and published by an eminent firm of publishers in these difficult days, is, we think, an occasion for surprise. *The Origin and Evolution of Freemasonry* is a good subject, and this book deals, we are told, not only with freemasonry, but also with the history of the human race; it shows whence man originated, and how he progressed in evolution, and reveals how the various religious cults have been evolved. This sounds excellent. We are going to be told all about the origins of freemasonry, and we anticipate reference to, and résumés of, the work of Darwin, Sir J. G. Fraser, Edward Carpenter, and others. And so we commence the book at Chapter I.

* * * * *

But Chapter I gave us a shock—well, no, not a shock, but a surprise. At first we thought that by an accident another book had been bound in our cover, an idea which turned out to be wrong. The book did deal with freemasonry, but not in Chapter I. There was, secondly, the possibility that the book was a conscious skit on the subject. This view also we abandoned. Chapter I, however, was evidently a digression. It dealt with the periodic law, corpuscles, and Socialists—a somewhat somnambulistic mixture. Not our old friend the periodic law of chemistry? Yes, the very same. Not by any chance the dear old corpuscles of the blood? No, the corpuscles or electrons of the atom instead. Good! And Socialists? Ah! it was very evident from the first that they were in for it. In the sequel they were going to get it pretty badly in the neck.

* * * * *

Chapter I commenced with an excellent but solemn warning to avoid the pitfalls of humbug and falsehood. "Knavery puts on the face of justice," we are told, and "Hypocrisy and superstition wear the vizard of piety." Wondering by what O. Henry-*dénouement* the author was going to connect these aphorisms with his subject, we read on, and came to the corpuscles and a somewhat out-of-date account of the structure of the atom. For this no blame need be attached to the author. It is not right to say, however, that there are 16,000 electrons in an oxygen atom. Divide this number by 2,000. Nor can electrons penetrate "the biggest block of steel"; a quarter of an inch would stop them all. But it is not to the author's knowledge of physics that we object; it is to the application of this business of corpuscles or electrons to everything. He universalises the periodic law of chemistry, whatever that may be. He calls it God's Law, the Law of Nature. It is true and

[1] *The Origin and Evolution of Freemasonry.* By Albert Churchward, M.D., M.R.C.P. (Allen & Unwin, 12*s.* 6*d.*)

immutable. Electrons, if you please, are God's little servants, or, if you like, God's little bricks. Instead of drawing a legitimate *analogy* between positive and negative chemical elements and optimistic and pessimistic people, he goes further, and states that the differences between the pairs are due to the same cause —corpuscles. For example, if you have sixty-seven corpuscles you are a pessimist, some other number and you are an optimist. Psychologists may learn that aphasia is very simply accounted for—in one paragraph on p. 26—by corpuscles. Shell-shock is "fully explained to the Physiologist" in another paragraph on p. 29; again by corpuscles. Life and the Universe change continually as the corpuscles multiply in numbers and in series, but "the Periodic Law remains true and immutable"—yes, even when the author expresses himself thus:

* * * * *

"Take a piece of iron and heat it to 30,000° C.; presto! these little corpuscles fly off and unite with others—the moist atmosphere—and form clouds, descending again as rain to form rivers and oceans. Again, 'the dead stars' clash together, and the result an ever-increasing temperature, until it has reached a degree of 30,000° C., and lo! a new star, a new world is formed, and at that temperature all are in the form of our little corpuscles; these gradually cool down again until the chemical elements of which this world is composed are found. This evolution and devolution is repeated, but God's little servants are never destroyed, not one."

* * * * *

Then we have this new method of describing the death of a soldier in battle:

"Here, for example, is a swarm of corpuscles vibrating, scintillant, martial—they call it a soldier; and, anon, in France or Germany that swarm dissolves—dissolves, forsooth, because of another little swarm they call shells. What a phantasmagoric dance it is, these corpuscles of atoms! Mark you the mutabilities of things. These same corpuscles, or others like them, come together again, vibrating, clustering, interlocking, combining, and the result is a woman, a flower, a blackbird or shark, as the case may be. But to-morrow the dance is ended and the corpuscles and atoms are far away—some in fever germs that broke up the dance; others are the green hair of the grave, and others are blown about the antipodes on the waves of the ocean, and the eternal ever-changing dance goes on."

This is eloquence, but what has it to do with the origin of freemasonry?

* * * * *

It is not to be wondered at that the writer of these paragraphs is at times "again" the scientists. The scientists are good enough fellows, you know, but "as a whole they have much to learn, and until they take the trouble to do so they will not make any real advancement or gain any real knowledge regarding the secrets of nature and the cosmic laws."

* * * * *

After these novel incursions into physics and physiology, we come to the Socialist, a poor creature, it appears, who attempts to explain things by "metaphysical arguments and Platonic terminology." He does not understand his "first cause," namely the Periodic Law of the Corpuscles and Elements. In other words, the poor old Socialist simply will not do.

* * * * *

So much for Chapter I, and it must be confessed that a reader would find it uncommonly hard to know what on earth all this has to do with freemasonry. But this is quite typical of the class of books we are dealing with. Their characteristics are irrelevance, a spirit of I-am-right-and-nearly-everybody-else-is-wrong, and the dogmatism of whatever-I-say-three-times-is-true.

* * * * *

We are not going to deal piecemeal with the rest. By the time we arrived at the part where freemasonry is discussed, we had become too sceptical to follow the author's closely knit argument. Every now and then a statement would make us sit bolt upright, but the periodical references to the Socialist and to the Periodic Laws calmed us down. One daring statement follows another. The author talks of freemasons living 600,000 years ago; of primitive cults lasting from 100,000 to 600,000 years. Maybe, but it is a little difficult to be quite sure. Then the corpuscles swarm in upon us again, and we are told that the Periodic Laws are immutable. The author then goes on to say that the mathematicians and astronomers of to-day were surpassed in knowledge by the men who built the Pyramids. We disagree profoundly. Sir E. Wallis Budge, the great authority on Egypt, in company with the Greeks, the Romans, and all classical scholars since the time of the Romans, are hauled over the coals for not being clever enough to read the sign language of the ancient Egyptians correctly. The author thinks he can do this, and makes a shot, and his attempt is the most interesting part of the book. But we look in vain for carefulness of statement, for the scientific spirit, for the desire to collate the results obtained with those of others, for humility of spirit. Instead: "I tell you all, my Brothers, because after forty years of hard study I have been permitted to know and learn these Divine Truths, both as regards this material world and also the Divine Laws of the

Spiritual and Everlasting State, and I write for you the Truth."

* * * * *

If the matter of this book be true, we should like the author to give us a really neat definition of error. But enough. Why should this sort of thing be served up to freemasons? And if the general reader be catered for, how can he fail to be nearly as ignorant of the origins of freemasonry at the end of his reading as he was at the beginning? And the symbolism, the politics, and the chemistry which permeate it will mystify him.

* * * * *

And for this book we do not blame the author, whose courage and energy we cannot but admire, nor need we quarrel very much with the publishers. No! I think the man we want to get at is the publisher's reader who let them down by inducing them to give this book to the world.

The Ems Telegram and the Franco-German War

By A. J. Grant, M.A.

Professor of History in the University of Leeds

THE Ems telegram—by which phrase is always meant Bismarck's editing and publication of the telegram sent to him by King William I of Prussia from Ems—has assumed in many quarters a fantastic importance. It is quoted as the damning proof of the mendacity of German Diplomacy; but for it, says Émile Ollivier, the French Chancellor, the war of 1870 would have been avoided; but for it, therefore, say some, the Great War, which is the continuation of the war of 1870, would have never come, and we should be living in a world ignorant of Sinn Fein and Bolshevism and a six-shilling income-tax, in a world happily unable to believe in the possibility of the agonies and the efforts of those years which already begin to seem more like nightmare than reality. It is the object of this paper to examine the real character of this famous transaction and to consider its importance.

At the beginning of January 1870 there was a moment of great relief in the international situation, which had since 1866, at least, been continuously tense and menacing. Napoleon III—prematurely old, seriously ill, without the quick imagination or the measure of will-power which he had once possessed—had made great concessions to the opposition. He had given France a new Constitution which seemed to establish something very like the English Parliamentary system, including the responsibility of Ministers. He had induced his old opponent, Émile Ollivier, to undertake the task of forming a Ministry. He had asked the nation by a plebiscite to say whether it approved of the new state of things, and 7,358,786 Frenchmen had by their votes assured him that they did. It is true that there were, even at home, black clouds on the horizon. More than a million and a half of voters had dared to vote against the Emperor in the plebiscite. Nearly two millions had not voted at all. Paris and the great towns were in opposition. Literature and thought were anti-Imperial. Victor Hugo's fulminations never ceased. But Émile Ollivier believed that the corner had been turned, and that France would now develop peacefully into a constitutional monarchy. To his sanguine temperament, the signs seemed to point to a calm in domestic politics.

He was equally hopeful in regard to foreign affairs. The tension had been very great. Four years before Bismarck and Prussia had overwhelmed Austria in the "Seven Weeks' War." Napoleon's efforts to gain for France some compensation, on the Rhine, in Luxemburg, or in Belgium, to balance the vast increase in the power and prestige of Prussia, had resulted in failure, and they had made French diplomatists, whether the Emperor or his Ministers, seem clumsy amateurs, deficient in knowledge and weak in will, in comparison with their great Prussian opponent. It was certain that Bismarck's mind was immovably set on the union of Germany under the leadership of Prussia, and that, if France resisted that project, he would gladly accept war. Many thought, like Prévost Paradol, that France and Germany were like locomotives running in opposite directions on a single line of rails, and that collision was inevitable. But Émile Ollivier's accession to the highest political office had, he hoped, changed that. He was willing to accept the union of Germany under Prussia. Why, then, should there be war? Ollivier believed that the danger was past. He told the Chamber at the beginning of July that the foreign horizon was unusually clear, and the English Foreign Office—where Lord Granville had just come into power—was of the same opinion.

All the world knows that this calm was destroyed by one of the most violent storms known to European history. It was known to the French Ambassador in Madrid, on July 2, that Leopold of Hohenzollern had accepted the Spanish throne. For twelve days France and Europe were in a constantly increasing fever of anxiety. War was practically voted by France on July 15; the Battle of Sedan was fought on September 2, and the Empire and Napoleon disappeared. It is only at the end of the Great War that we can

find such a succession of catastrophes as this. The question that we ask ourselves is, " What part was played in them by the affair of the Ems telegram ? "

Our knowledge of the part played by Bismarck in these great events is largely derived from his Memoirs, and it is from that source almost entirely that our knowledge of the incident of the telegram comes. The Memoirs were written or dictated in his old age, after he had been dismissed from office by the Emperor, and, like most autobiographies, they show a desire to give a certain colour to the past ; they contain a fair crop of inaccuracies ; and at one extremely important point they are guilty of so flagrant a suppression of the truth that it amounts clearly to a suggestion of the false. The story there given of the Ems telegram is by no means without its difficulties, and has been severely criticised by some German writers. I shall not examine these criticisms here, but shall accept those famous pages as an accurate statement. It is impossible, within the limits allowed to an article by DISCOVERY, to reproduce them. They can only be summarised.

The situation was briefly this. France had protested against a Prussian candidate for the Spanish throne, and had clearly stated her readiness to prevent the accession of Leopold of Hohenzollern, even by war. For a moment war had seemed certain. Then Leopold had been induced to resign, and the war cloud seemed lifted from Europe. Then in an evil hour, and without consulting his Chancellor Ollivier, Napoleon III had instructed his representative at Ems, where the Prussian King was taking the cure, to demand guarantees for the future. William I must declare his personal approval of Leopold's renunciation, and must promise never in the future to give the candidature his support. On this condition there would be peace, but, it was implied, on no other. Again war seemed certain, and again the danger passed. For William was conciliatory and good-humoured. He yielded something ; he showed without irritation the impossibility of yielding all. The famous interview with Benedetti, the French Ambassador, passed off on the esplanade at Ems without any approach to violence of language or feeling. Benedetti was relieved. In Paris a cooler mood had come to the Imperial Council. There was a disposition to accept what had been won and to be satisfied. The King, too, believed that the crisis was past, and instructed his secretary to telegraph the result of the interview to Bismarck at Berlin. This telegram has been often reprinted, but it is necessary for the purpose of this article to print it once again (the telegram is from the King's secretary, Abeken) :

" His Majesty writes to me : ' Count Benedetti spoke to me on the promenade in order to demand from me, finally in a very importunate manner, that I should authorise him to telegraph at once that I bound myself for all future time never again to give my consent if the Hohenzollerns should renew their candidature. I refused at last somewhat sternly, as it is neither right nor possible to undertake engagements of this kind *à tout jamais*. Naturally I told him that I had as yet received no news, and as he was earlier informed about Paris and Madrid than myself, he could clearly see that my Government once more had no hand in the matter.' His Majesty has since received a letter from the Prince. His Majesty, having told Count Benedetti that he was awaiting news from the Prince, has decided with reference to the above demand, upon the representation of Count Eulenburg and myself, not to receive Count Benedetti again, but only to let him be informed through an aide-de-camp : that His Majesty had now received from the Prince confirmation of the news which Benedetti had already received from Paris, and had nothing further to say to the Ambassador. His Majesty leaves it to your Excellency whether Benedetti's fresh demand and its rejection should not be at once communicated both to our Ambassador and to the Press."

Bismarck was dining with Moltke and Roon (the War Minister) when he received this telegram. He was displeased with the independent way in which the King of Prussia had conducted the negotiation, and had determined to resign office as a protest. When the telegram had been deciphered by his clerk he read it out to his guests. They interpreted it to mean that the war crisis was over, and " their dejection was so great that they turned away from food and drink." Then Bismarck asked them as to the condition of the army and received satisfactory answers. He tells us that he was himself convinced of the necessity of immediate war if Prussia was to avoid a deep humiliation. He considered in what form he should communicate the news to the Press. The King's telegram permitted him to do so, and even suggested that it should be done ; but the language does not justify Bismarck in saying, as he does, that he was " commanded " to communicate it " immediately." So " in presence of my two guests I reduced the telegram by striking out words, but without adding or altering " (we will consider in a moment whether this is strictly true), to the following form :

" After the news of the renunciation of the hereditary Prince of Hohenzollern had been officially communicated to the Imperial Government of France by the Royal Government of Spain, the French Ambassador at Ems further demanded of His Majesty the King that he would authorise him to telegraph to Paris that His Majesty the King bound himself for all future time never again to give his consent if the Hohen-

zollerns should renew their candidature. His Majesty the King thereupon decided not to receive the French Ambassador again, and sent to tell him through the aide-de-camp on duty that His Majesty had nothing further to communicate to the Ambassador."

The new version was read out to the soldier and the statesman, and was received by them with joyous acclamation. Moltke declared that the first version had been a " parley " ; this was a challenge. Roon said, " Our God of old lives still and will not let us perish in disgrace." Both regarded it as a step towards almost certain war. In the amended form it was telegraphed at once to all German Ambassadors and was communicated to the Press. It was published in Berlin in a separate slip, which was given away with the evening papers and fastened on the walls and shop windows. It was, of course, telegraphed at once to Paris, fell like a bomb on Ollivier, who was beginning to feel sure of peace, and produced such an effect on the Press and the public of Paris that the declaration of war, which immediately followed, could hardly have been avoided. We must not follow the story, but will consider these questions : (1) What was the nature of Bismarck's rehandling of the King's telegram ? Does it deserve to be called forgery or falsification ? (2) What was its real influence on the outbreak of the war ?

(1) Was Bismarck's action forgery or falsification ? It was at one time usual to speak of the " forgery " of the Ems telegram. Of late it has been often denied that it was even a " falsification." It is surely possible to come on this point to a quite definite decision. We have printed the original telegram and Bismarck's version of it which was communicated to the Press and the public. The first despatch may be analysed as follows : (1) Benedetti made demands which I refused ; (2) I subsequently received official news of Leopold's renunciation of the Spanish crown ; (3) so I told Benedetti that I could not see him again ; (4) I leave it to you whether that should be made public or not. It is clear that this was a private telegram, and could not be published in the form in which it was received. Bismarck says that he made " no alteration in or addition to the telegram." But that judgment cannot be maintained if the two versions are closely compared. The second version says in effect : (1) Benedetti presented certain demands to the King of Prussia ; (2) *thereupon* the King refused to hold further communications with him. If there is any doubt as to the wide difference between the received and the published version, it will be well to lay stress on the word *thereupon*. It is not too much to say that the published version gives a false account of an all-important incident. The King had refused to continue negotiations with Benedetti. That was certainly true. But why ? The King's telegram said, because official news of Leopold's renunciation had been received. Bismarck's version said because Benedetti's demands were outrageous. The first declines to continue the negotiations because the incident has been closed by what has happened elsewhere ; the second, because the negotiator has presented outrageous demands. This rehandling of the King's telegram may not deserve to be called " forgery," but assuredly it is a " falsification." Perhaps Moltke exaggerated when he called the first a parley and the second a challenge : but Bismarck and his guests were the best of judges, and they knew that the first meant peace at least for a time, and the second meant immediate war.

(2) The second question is a much more difficult one, and the answer cannot be given with certainty. What is the relation of Bismarck's action to the great war which was so soon to come ? Did the falsification of the telegram cause the war or precipitate it ? The word " cause " is used very loosely by historians, and a thorough examination of its meaning is seriously wanted. But no one will be found to maintain that Bismarck's telegram was in any strict sense the cause of the war. It was an incident in a long rivalry ; a symptom of the anarchy of Europe ; its roots stretch far back into history and into human nature. But if we see in history the operation of great causes, we must see also the occasional vast importance of small incidents ; and it is a part of the task of history to establish the relation between the two.

There can be no doubt that the publication of the telegram was for the moment of decisive importance. Perhaps Bismarck's Memoirs, written in his disappointed and egotistic old age, claim for his slightest actions more importance than properly belongs to them. We have, however, in Ollivier's autobiography, which he calls *L'Empire Libéral*, evidence that cannot be set aside. Émile Ollivier was not a great man, but he was an excellent writer. His book has suffered through its immense length, for it extends to seventeen volumes. The fourteenth, which deals with the coming of the Franco-German War, can be quite well read by itself, and is one of the most fascinating pieces of political autobiography. It is supported by documents (which Bismarck's book is not) and checked by reference to other writers. His opinion is clear. He had always desired peace, and peace, which had threatened to escape him, seemed safe at last. The situation was not without difficulties—a strong current of opinion in Paris and in France would have been bitterly disappointed ; but the result could not be altered. Peace was in his hands, and he hoped to go forward to establish it firmly. On the morning of the fourteenth of July Ollivier was actually engaged on a declaration

which should be read to the Assembly. It was couched in a note of triumph: "To-day we are certain that a foreign prince will not sit on the throne of Spain. This victory is the more precious because it has been won by the force of reason and of right, and has not cost the sacrifice of life. . . . We asked your support against a Prussian candidate for the throne of Spain. That candidature has been withdrawn. We can now take up again with confidence the work of peace." Here let Ollivier speak for himself: "I was going on to speak of the part played by Olozaga and by Spain, when the door was opened and the usher announced 'His Excellency the Minister of Foreign Affairs' (the Duc de Gramont). As soon as he had passed the door, before ever he had reached the middle of my room, he exclaimed, 'My friend, you see a man who has just been struck in the face.' I rose. 'I don't understand you; explain yourself.' He held out to me a little sheet of yellow paper which I shall see for ever. It was a telegram from Lesourd, sent from Berlin thirteen minutes after midnight, and ran, 'A supplement to the *Gazette* of Northern Germany which came out at ten o'clock contains the following announcement.' There followed Bismarck's telegram. . . . Never was a vessel wrecked so near to harbour. I remained a few minutes silent and crushed. 'There is no room for any further illusion,' I said; 'they mean to force us to war.'" I am not here discussing the wisdom of Ollivier's policy, nor the soundness of his judgment, but merely considering the effect which Bismarck's telegram produced in France. There can be no doubt that Ollivier was devoted to the cause of peace. He says: "Drops of sweat, the result of my mental anguish, stood upon my brow. Et in agonia ego. . . . But I always came to the same conclusion. France had been insulted intentionally and grossly, and we should be faithless guardians of her honour if we tolerated it." The news had meanwhile spread to the boulevards, and on all sides were heard cries of "Vive la guerre! À Berlin!" The decision of the Assembly and the declaration of the Emperor did but ratify the opinion of the Ministers and of France.

It is, then, certain that the publication of the telegram was the occasion which inflamed the war fever in Germany (where the incident at Ems was regarded as an insult to Prussia) and ruined the hopes of the French Chancellor. But that is far from saying that it was the cause of the war. If the telegram had not been published, what course would events have taken? There would have been a precious moment in which the basis of a real pacification might have been laid, especially if Bismarck had carried out his threat of resigning office. Ollivier might have shown himself possessed "of the genius of Cavour and Bismarck combined" (the phrase was used of him by a correspondent, and he quotes it with characteristic naïveté). On the other hand, it is possible—and probable—that a new crisis would very soon have arisen—there had been a series of Franco-Prussian crises since 1866: that Ollivier, who only possessed half of Napoleon's confidence, would have failed to deal with it, and that war would have entered a little later by a slightly different gate.

The ethical aspect of the incident may be briefly dealt with. Bismarck's action has been represented as an unparalleled act of diabolical cleverness. No diplomatic incident has acquired such celebrity. During the Great War it was constantly used as a weapon wherewith to beat the policy and diplomacy of Germany. Now that the passions of that time are dying down, it is possible again to see the incident in its true light. Bismarck had in his hands at that moment peace and war: he chose war; and he obtained it by falsifying the account of the interview between his King and the French Ambassador. That is a terrible responsibility. But European history would not be the crime-laden record that it is if his action stood out in solitary infamy among the doings of statesmen and diplomatists. It is not difficult to understand how Germany can forgive a statesman who by a stroke of the pen brought on, at a moment favourable to his own country, a war which he believed to be necessary and inevitable. There are far worse incidents in the career of Frederick the Great. Are not many incidents quite as bad to be found in the records of English statesmen, crowned and uncrowned, whom posterity has made up its mind to honour?

The Structure of the Atom

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In chemistry an element may be defined as a distinct kind of matter that has not yet been shown to be composite. Pure gold, for example, is called an element because no one has yet succeeded in showing that it is really made up of two or more other substances. Brass, although, like gold, a metal and resembling it somewhat in appearance, is not an element, because it is made from copper and zinc, and may be easily changed back into these metals. Oxygen gas, although about as different from gold as anything could be, resembles it in one respect at least. It is an element. Water, on the other hand, which contains oxygen and hydrogen in combination, can easily be shown to be

a compound. By passing an electric current through it its elements, hydrogen and oxygen, are obtained.

An element or an elementary substance is supposed to be an aggregate of minute particles which are called atoms. These atoms are supposed to be the same in every respect; they are indivisible. What they look like is of no importance, for nobody will ever see them—they are much too small—but most people imagine them as little hard spheres like tiny balls of steel. All atoms of any particular element have the same size and weight, but the weights of atoms of different elements are very different. The atom of uranium, the element whose atom is the heaviest, is 236 times that of hydrogen, the lightest; that of iron is three and a half times heavier than that of oxygen; that of oxygen is four times the weight of the atom of helium; that of helium nearly four times that of hydrogen.

These weights cannot conceivably be measured directly, i.e. by weighing the atoms singly in turn. The atomic weight of an element has to be determined indirectly, following certain laws and assumptions which are at the very root of the science of chemistry. How this is done need not concern us here. Suffice it to say that when the atomic weights of different elements are determined, these values are expressed not as very small fractions of a very small weight such as an ounce, a grain, or a gramme, but more simply as numbers on a scale. One must remember that these numbers, although called "atomic weights," are for purposes of comparison only. They are not the actual weights of the atoms. The atomic weight of oxygen is chosen as 16. It is the standard of comparison. Uranium is then found to have an atomic weight of 238, so that the uranium atom is $\frac{238}{16}$ times heavier than that of oxygen. Lead has an atomic weight of 207; tin of 119; copper, 63; iron, 56; chlorine, 35·5; nitrogen, 14; and hydrogen just a little greater than 1. From these numbers one can work out, if one wishes, the relative weights of these elements with regard to each other or to oxygen. With a table of the atomic weights of the elements before one, a glance is sufficient to show what are the relative weights of the elements, and it is as easy to arrange the chemical elements in increasing order of their atomic weights as it is to arrange a series of numbers so that each is less than the one which follows it.

Why is one atom heavier than another? One simple answer to this question was that given by the chemist Prout. He imagined that all the elements were in some way built up of hydrogen atoms; consequently, the more hydrogen atoms it contained, the heavier was the atom. But if an atom be composed of a number of the lightest (hydrogen) atoms, it must be composed in a very special way, for if it is a composition of the kind usually met with in chemistry, one would imagine that in time someone would manage to split it up into simpler parts. This, however, has not been done. An element is an element, and cannot, except in a very special manner, as we shall see later, be split up. Without passing any judgment on this idea of Prout's, let us answer the question by saying that one atom differs in weight from another because it has a different structure.

Now, the structure of the atom is so new a subject that it will be several years yet before one has a pretty definite theory of just what that structure is. A short account of the principal points of the theory may, however, be given now. It represents in outline the present ideas.

The atoms of all the elements are supposed to have the same general structure. A description of one atom, therefore, answers for a description of all. An atom is supposed to be composed of positive and negative electricity only. The positive electricity is supposed to be at the centre of the atom, forming a core there; or, as it is called, a nucleus. Surrounding this nucleus are separate particles of negative electricity (called electrons), which are spaced out to occupy the rest of the atom. The important things about the nucleus are: (*a*) its size, which is very minute compared with the size of the atom; (*b*) the fact that "practically the whole" of the mass (or weight) of the atom is concentrated on this tiny nucleus, paradoxical as this may appear to be; and (*c*) the fact that the nucleus may have in it both negative and positive electricity "slumped together"; but it appears to be positive electricity only, because there is always more of the latter than of the former. The negative electricity, on the other hand, is not "slumped together," but exists as separate little entities (electrons), which may revolve round the nucleus analogously to the movement of the planets round the sun, or may simply be stationary. The size of each of these entities of negative electricity is very small compared with the diameter of the atom, but it is somewhat larger than *the whole* of the positive nucleus. As there is but one nucleus, and as the number of electrons in an atom is never greater than 92 (experiment proves this), and as all are very minute compared with the size of an atom, it follows that most of an atom—more than 99·99 per cent. of it—is empty space. Consider an atom so magnified as to appear superficially like Ireland. On that scale the nucleus, situated at Athlone, would be a ball of 8 feet in radius only. Round that, at different distances from Athlone to the sea, would be some forty or fifty (on the average) spheres of about the same radius, and *these and the nucleus are the whole of the atom.*

An atom, then, in some respects resembles the solar system. The solar system, if you come to think of it,

is mostly space ; for the distances between the planets, and between each planet and the sun, are enormous compared with the size of the planets or of the sun. It resembles it further in this, that very probably the electrons revolve round the nucleus in the atom, like planets round the sun. But the analogy need not be pressed further.

The *amount* of positive electricity on the nucleus of the atom, and the *number* of electrons in the atom, are invariably the same numerically. Thus, an atom whose nucleus has a charge of 22 positive units has 22 electrons. The lead atom, for example, has 82 positive charges on its nucleus and 82 electrons ; the oxygen atom 8 positive charges on its nucleus and 8 surrounding electrons ; the helium atom 2 and 2 ; the hydrogen atom 1 and 1. This number, which is both the number of electrons in the atom and the number of positive charges of electricity on the nucleus, is an important one. It is called the Atomic Number. Each element has one atomic number and one only ; its chemical and physical properties depend upon this magnitude, for they depend solely on the *amount* of the charge on the nucleus. Change the atomic number (if you can), and you change the chemical and physical properties of the body ; that is, you make a new element.

I have tried to show, then, that atoms differ in weight and chemical properties because of slight differences in their general structure. These differences are occasioned by differences in the number of positive charges on the cores or nuclei of the different atoms, and concurrently with this, in the number of electrons which surround the nuclei.

This important number, the Atomic Number, is very easily obtained. One simply arranges the whole of the elements in increasing order of their atomic weights, and numbers them off from the lowest like soldiers. Hydrogen is the element of lightest atomic weight. Its atomic number is therefore 1, its nucleus has a charge of 1 positive unit of electricity, it has 1 electron. Helium is the next lightest. Its atomic number is therefore 2, its nucleus has a charge of 2 positive units, it has 2 electrons. Lithium is the third lightest, hence, etc. Iron stands twenty-sixth in order of lightness of atoms. It has therefore a charge of 26 positive units on its nucleus, and 26 electrons. The statement applies to every element. Uranium, the heaviest of the elements, stands ninety-second in order. Its nucleus has 92 positive charges, and round it are its 92 electrons.

Note that it is not the number of electrons (each of which is probably the same in size whatever atom it occurs in) that makes the weight of the atom. The electrons are supposed each to have a weight of only $\frac{1}{1850}$ of that of the lightest atom, so that their weight is negligible. The seat of the weight of the atom, as I mentioned above, lies in the nucleus. Each positive charge of electricity corresponds to from 2 to $2\frac{1}{2}$ units of atomic weight, depending upon whether the atom be light or heavy. Oxygen, for example, has an atomic number of 8 and an atomic weight of 16 ; tin an atomic number of 50 and an atomic weight of 119 ; lead an atomic number of 82 and an atomic weight of 207.

The transmutation of the elements is a subject that has always appealed to the imagination of man. Many people spent their valuable lives during the Middle Ages attempting to make the noble metals out of the baser sort. Seventeen years ago a firm in Scotland, with a capital of between £50,000 and £100,000, tried the experiment also as a side line to their proper work. The present theory of the structure of the atom, had they known it, would have convinced all these alchemists that the difficulty of transmutation was greater than they may have imagined, even in their most pessimistic moments.

Gold has an atomic number of 79, mercury of 80. To transmute mercury, which is comparatively cheap, into an equal weight of gold, all one has to do, if the present theory be true, is to reduce its atomic number by one. To do this one has simply to knock out one of the positive charges from the nucleus of mercury. This will reduce the nucleus to 79 charges, and I am quite sure the 80 surrounding electrons will then take up a new set of positions, and expel one of their number so that they too will number 79. The body with the nucleus of 79 charges will be gold. No possible doubt whatever about that. The great difficulty is to knock out that single charge from the nucleus of the atom of mercury. That is extremely difficult. Why ? Well, first of all, you have to get hold of some tiny projectile corresponding to the ball (now, alas, twopence !) that brings down the cocoanut. This must be something small because it has to penetrate the atom. A tiny atom would do, helium or hydrogen for example. Next, this small atom, in order to penetrate bodies, must be moving with a considerable velocity, since it is hitting the " outsides " of other atoms at every stage and so losing velocity. The next difficulty is that the nucleus is so small compared with the size of the atom, being " mostly empty space," that only one shot in many millions is likely to hit the nucleus. Most shots will go right through the atom and miss the nucleus altogether. To be near is not enough. The near shots are simply bent round the nucleus as a comet is deflected round the sun. Once, however, the nucleus is really hit with sufficient energy by the projectile it is likely to be broken up. It will lose some of its electric charge, and so will form with its new set of surrounding electrons a different atom.

Repeat the process often enough, and you may obtain enough of these broken atoms to form a weighable amount of a different substance. In the case of mercury (atomic number 80), you might produce in this way gold (atomic number 79), or perhaps platinum (atomic number 78).

Professor Rutherford, of Cambridge, has shown that artificial transmutation of one element into another by the method sketched above is possible. In his experiments he used as projectiles the high-speed particles spontaneously emitted by the radio-active element, radium C. These particles consist of atoms of helium moving with a velocity of some 12,000 miles per second. The atoms struck were those of the element nitrogen (atomic number 7). Professor Rutherford showed that from a very small percentage of these atoms, atoms of hydrogen were produced. It is believed that these are produced by the rupturing of the nucleus of the nitrogen atom by the high-speed particles of helium. This is the first occasion on which artificial transmutation of one element into another has been successfully carried out. Further work along these lines is, of course, merrily in progress.

Legal Minimum Wages

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I

THE whole problem of wages is very much to the fore at the present time, but it is only with one aspect of the problem that I am immediately concerned. In order, however, that the question of legal minimum wages may be seen in its proper perspective, it will be necessary to touch briefly on the larger questions of (*a*) the state regulation of wages in general, and (*b*) wages settlements by conciliation and arbitration.

At the outset I wish to make clear what is understood by "legal minimum wages." The expression implies two things: (1) that rates of wages have been fixed by Parliament, or by some body or person charged with that duty by Act of Parliament, and (2) that any employer paying lower rates than those legally fixed is liable to a penalty in accordance with an Act of Parliament. A legal minimum rate may be contrasted with (*a*) a standard rate, i.e. a rate normally paid in a particular occupation, and (*b*) a maximum rate, i.e. a rate which may not be exceeded under penalty. A standard rate is commonly fixed by agreement between organisations of employers and workers, or by arbitration; thus the 2*s*. 5*d*. per hour paid to plumbers in Liverpool may be quoted as an illustration of a standard rate. Maximum rates existed long before standard rates or minimum rates were thought of, but the last Act regulating the subject was repealed about 100 years ago. The wages assessments issued by the Justices of the Peace under the Statute of Apprentices, 1563, all represented cases of legal maximum wages. The penalty for giving wages higher than the rate was ten days' imprisonment and a fine of £5; the penalty for receiving wages higher than the rate was twenty-one days' imprisonment. A Warwickshire Wages Assessment in 1738 fixed the rate for a mason in summer at 10*d*. a day with drink, and at 1*s*. a day without drink. The 10*d*. and the 1*s*. are illustrations of legal maximum wages.

The conception of a legal minimum wage, dissociated entirely from any legal maximum wage, is quite modern. It was suggested as a means of dealing with the problem of "sweated" labour. The mere pittances paid to certain classes of labour, especially to women, more particularly those working at home, or employed by sub-contractors, had become sufficiently recognised as a public scandal to cause the Government to move in the first decade of the present century. In 1907 a commissioner was sent to Australia to investigate the Wages Boards established there, and in 1908 the House of Commons appointed a Select Committee on Home Work. It was on the recommendation of this Committee that the Trade Boards Act, 1909, was passed.

The Act might be applied to any specified trade if the rate of wages prevailing in any branch of the trade was exceptionally low as compared with that of other employments. At the outset four trades were covered by the Act: tailoring, paper-box making, lace finishing, and chain-making. In 1913 linen and cotton embroidery, hollow-ware making, sugar confectionery and food preserving, and tin-box making were brought under the Act. The number of workers affected in these eight trades was about 400,000. One of the worst cases of an exceptionally low-wage occupation, viz. agriculture, was not provided for until 1917, when an Agricultural Wages Board, with power to fix legal minimum wages, was established under the Corn Production Act, 1917.

A new aspect of the problem of legal minimum wages dates from 1918, when a new Trade Boards Act was passed, which could be applied by the Minister of Labour to any specified trade in which no adequate machinery existed for the effective regulation of wages throughout the trade. In other words, whilst the Trade Boards Act, 1909, applied to "sweated" trades, the Trade Boards Act, 1918, applies to badly organised trades. The Minister of Labour has made, and is making, considerable use of his powers under the new

Act, and it is estimated that by the end of this year some three million workers will be covered by Trade Boards. Included amongst these workers are those employed in grocers' shops, in laundries, in tobacco factories, in aerated water works, in jute, flax and hemp mills, in boot and shoe repairing, and in the distribution of milk.

Before dealing more fully with the constitution and functions of Trade Boards, reference must be made to two other ways in which the State of recent years has participated in the regulation of wages. (1) Under the Munitions of War Acts, 1915 to 1917, arbitration tribunals with compulsory powers were established. The Committee on Production was probably the best known of these tribunals. These arbitration tribunals fixed standard rates; failure to comply with the decisions was punishable by penalties through a Munitions Tribunal. This system of compulsory arbitration was largely done away with after the Armistice, though it was not finally abolished until Sept. 30, 1920. (2) From time to time the Government arranges for the holding of an impartial investigation with regard to the proper rates of remuneration in some particular occupation. Any recommendation made by such committee or Court has no binding force, but it is hoped that the parties concerned will accept it of their own accord or as a result of the pressure of public opinion. The Burnham Committees on teachers' salaries and the Court of Inquiry on dockers' wages may be mentioned as illustrations of this type of procedure.

II

The first step to be taken in order to fix legal minimum wages in a trade is to establish a Trade Board for that trade. A Trade Board consists of members representing employers and of members representing workers in equal numbers, and of three (occasionally five) independent persons—generally professional men or women—known as the "appointed members." The Chairman and Deputy Chairman are always selected by the Ministry of Labour from amongst the "appointed members." The size of the Boards varies: on the Button-making Trade Board, for example, there are 16 on the employers' side and 16 on the workers' side, together with 3 "appointed members"; whilst on the Grocery and Provision Trade Board there are 39 on the employers' side and 39 on the workers' side, together with 5 "appointed members."

A Trade Board's method of reaching a wages settlement lies in between the methods of conciliation and arbitration. Arbitration may be defined as an authoritative decision of an issue, as to which the parties have failed to agree, by some person or persons other than the parties. Conciliation, on the other hand, is the discussion and settlement of a question between the parties themselves, or their representatives, who are actually interested.

A Trade Board seeks to reach its decisions by agreement between the two sides, with or without the assistance of the "appointed members" as intermediaries. If successful, it acts like a Conciliation Board with an independent Chairman. On the other hand, it differs from a Conciliation Board in that, if the two sides do not agree, instead of a deadlock resulting, a decision can usually be obtained by voting; each member of a Trade Board has a vote, and if there is no cross-voting between the two sides, the votes of the "appointed members" should give a majority in favour of the proposals or of the counter-proposals before the Board.

The fact that the "appointed members," as well as the representative members, have votes does not make the "appointed members" into arbitrators—they have no power to give an authoritative decision. If the two sides are evenly divided on some question the "appointed members" can turn the balance in favour of one side or the other, but they cannot impose upon the trade some settlement which has the support of neither side on the Board.

The Trade Board method of reaching wages settlements appears to have certain advantages over the arbitration method:

1. A Trade Board cannot give a decision which is disapproved of by both employers and workers, which may quite well be the case with the decision of an arbitration tribunal.

2. A Trade Board, when once established, is a permanent body which meets periodically. The results of this, apart from enabling the two sides to get to know each other, which is likely to facilitate the securing of decisions by agreement, are as follows: (*a*) The "appointed members" have an opportunity of acquiring some knowledge of the trade for which they legislate, whereas the independent members of an arbitration tribunal are almost necessarily ignorant of the industry under consideration. (*b*) A Trade Board deals with any particular wages question from its earliest inception, whereas an arbitration tribunal does not handle a wages question until it has reached an exceedingly acute stage—which makes it far more difficult to find a satisfactory solution. (*c*) A Trade Board is responsible for the carrying out of its own decisions. If it makes mistakes it has sooner or later to rectify them. It consequently tends to be cautious in its decisions and to feel its way carefully. An arbitration tribunal, on the other hand, is set up for a particular purpose; once its decision is given, it has no further interest in the particular problem; how its decision will work, and what its effects on the trade

will be, are not its concerns. Under these circumstances it is hardly surprising that arbitration awards are sometimes a greater source of trouble than the original disagreements which were submitted to arbitration.

3. A separate arbitration tribunal being constituted to deal with every dispute, there is a serious danger of a great divergence in the decisions reached by arbitration. Thus one tribunal may fix women's wages at one-half of the men's rates, another at two-thirds of the men's rates, and still another at four-fifths of the men's rates. In a similar manner, diversity may occur in the solution of all the problems submitted to arbitration, and the more this happens the more dissatisfaction there will tend to be.

Obviously there can be no question of absolute uniformity in the decisions of the various Trade Boards. Had that been desired, it would have been necessary to set up one Trade Board for all trades, instead of a separate Trade Board for each trade. Each Trade Board has its own problems to solve and must deal with them on their merits. Nevertheless, the fundamental principles underlying the various decisions will tend to be the same, and it should be possible to secure some degree of uniformity. As a matter of fact, this is achieved in a considerable measure by the thirty odd Trade Boards in Great Britain as a result of three co-ordinating influences:

(*a*) The same men and women commonly serve as "appointed members" on several Boards, and thus tend to keep the different Boards in touch with each other.

(*b*) One man is secretary of all the Boards, and he or his deputy is always willing, if invited to do so, to place his intimate knowledge of the working of all Trade Boards at the disposal of any particular Board.

(*c*) All rates fixed by Trade Boards have to be confirmed by the Minister of Labour before they can come into force. This does not mean that the Minister seeks to dictate to Trade Boards what they shall do, but that he is responsible to Parliament for seeing that Trade Boards do nothing which is not expressly authorised by the Trade Boards Acts. How the check on Trade Boards works in practice depends very much upon the broadmindedness with which the permanent officials at the headquarters of the Ministry of Labour discharge their functions. These officials, unlike the secretary and the "appointed members," are not in close touch with the employers and workers on the various Boards, and there is always a danger that, instead of taking a common-sense point of view of any particular problem, they will adopt a narrow-minded and strictly legalistic attitude and strive to follow the letter rather than the spirit of the law. In such a case the Ministry would tend to devote much of its time to solving such riddles as "When is overtime not overtime?" or "When is a week not a week?" and in inflicting its solutions of the riddles upon the various Boards.

In practice, the control of the Minister of Labour, through his power to refuse to confirm the proposals of Trade Boards, appears to act as a check in minor rather than in major matters.

III

The problems which face Trade Boards, and more especially the "appointed members," appear to be a good deal more difficult to-day than they were a few years ago. (*a*) Before the war the Boards were concerned only with "sweated" industries; now they are frequently concerned with industries of a higher type, and there is a tendency to invoke the machinery of a Trade Board to help not merely the lower-wage, but also the higher-wage, sections of the workers. Whereas an old Trade Board, such as the Hollow-ware Board, has fixed only one rate for men and one rate for women (apart from overtime), a new Trade Board, such as the Button-making Board, has made special provision for skilled workers and for piece-workers; thus there is one time-rate for unskilled men and a higher time-rate for skilled men, and a further provision that where skilled men are paid piece-rates, the rates must be so fixed as to enable men to earn at least "time and a quarter." At the present moment certain retail trades are being brought within the scope of the Trade Boards Acts, and the complexities with which the "appointed members" are faced appear to be greater than ever. (*b*) The great instability of prices to-day, as compared with pre-war days, seriously magnifies the work of the Trade Boards.

If, after discussions and negotiations, the two sides of a Board can agree about any particular matter, the "appointed members" feel that they are relieved of any responsibility for the decision reached, and that they have done their share of the work in helping forward the negotiations which have led to the agreement.

If, however, after discussion and negotiations, the two sides of a Board do not agree about some essential matter, such as the fixing of general minimum time rates, then a very serious responsibility falls upon the "appointed members," who can, apparently, adopt one of three courses: (1) they can vote in favour of the proposals of either one side or the other, and thus enable the Board to reach a decision; (2) they can refrain from voting, or can vote against both sides, if they feel that they cannot support the proposals of either side, and instead they can put forward tentative suggestions of their own, in the hope of being able to win one side, if not both sides, to voting for them, or some modification of them which may seem acceptable; (3) in the last resort, they can report

to the Minister of Labour that the Board is unable to fix general minimum time rates.

It not infrequently happens that, either formally or informally, the "appointed members" have to put forward suggestions for the consideration of the two sides, with a view to bridging differences. By what principle, it may be asked, are the "appointed members" governed in making their suggestions with regard to wages? At the outset it should be stated that the Trade Boards Acts appear to contain no instructions for the guidance of Boards, but the Corn Production Act has a sub-section to the following effect: "In fixing minimum rates . . . the Agricultural Wages Board shall, so far as practicable, secure for able-bodied men wages which, in the opinion of the Board, are adequate to promote efficiency and to enable a man in an ordinary case to maintain himself and his family in accordance with such standard of comfort as may be reasonable in relation to the matter of his occupation."

I cannot attempt to lay down the principles on which a Trade Board should act in determining minimum wages, but I venture to suggest that the following considerations, among others, are likely to have weight with the "appointed members," if not with a Board as a whole:

1. The need for enabling a worker to maintain a reasonable standard of life. Even in the case of a minimum wage, something more than a mere subsistence allowance, in the sense of what is necessary to keep the body and soul of the worker together, should be aimed at; but it is hardly possible, when dealing with a minimum wage, to accept the view of the Dockers' Court of Inquiry which had reference to standard wages. That Court held that dockers had "a right to have life ordered upon a higher standard [than merely a subsistence allowance], with full regard to those comforts and decencies which are promotive of better habits, which give a chance for the development of a greater sense of self-respect, and which betoken a higher regard for the place occupied by these workers in the scheme of citizenship." What exactly this standard amounts to, in terms of the necessaries, comforts, and luxuries of life, was not stated. Dr. Bowley, Professor of Statistics in the University of London, estimated 73*s.* 6*d.* out of London, and 77*s.* in London, as the expense of procuring a decent standard of life for a family of a man, wife, and three children. The Court, in March 1920, recommended 16*s.* a day, or 88*s.* a week.

2. Variations in the cost of living. This was recognised already in connection with the wages assessment made under the Statute of Apprentices. The Justices, before settling wages, were to call unto them "such discreet and grave persons of the . . . county or city as they should think meet," and they were to confer together "respecting the plenty or scarcity of the time." Nowadays, members of Trade Boards consult the latest number of the *Labour Gazette* to ascertain the most recent figure for the percentage increase in the cost of living since July 1914.

3. What the best employers in the particular trade are already paying.

4. The existing rates of remuneration of occupations of similar standing in other trades.

5. What wages the particular trade will bear. This consideration raises a variety of possibilities:

(*a*) The possibility of the increased wages bill being passed on to the consumer in the form of higher prices.

(*b*) The possibility of less efficient workers being dismissed.

(*c*) The possibility of smaller employers being eliminated and displaced by larger employers.

(*d*) The possibility of the industry being handicapped in its struggle with foreign competitors.

(*e*) The possibility of labour being displaced by machinery.

(*f*) The possibility of higher wages rendering labour more efficient so that a corresponding, or even more than corresponding, increase in output is secured.

(*g*) The possibility of the increased wages bill being met entirely out of profits.

(*h*) The possibility of the higher wages acting as an inducement to employers to reorganise their businesses, with a view to eliminating wasteful methods.

6. Variations prevailing in different parts of the country, both in respect of cost of living and in respect of what the trade will bear, more especially in the case of those trades, such as the grocery business, which are carried on in all types of area, from the biggest town to the smallest country village.

7. The grading of the workers within any particular trade, if more than the lowest grade is to be given protection. If the workers in a trade can be roughly divided into two classes, skilled and unskilled, the problem of the relation of the wages of the higher to the lower grade is not very serious; if, however, it is necessary to distinguish several distinct grades, as apparently in the grocery trade, then the work of securing the proper proportions between the wages of the different grades, without making the rate for the lowest grade too low, or the rate for the highest grade too high, is a task of considerable difficulty.

8. In the case of rates for juveniles, care must be taken not to fix wages in such a manner as to promote wholesale dismissals when youths become adults. At the same time, rates must not be fixed so high as to deter employers from engaging juvenile labour, nor so low as to deter juveniles from entering the trade.

9. In the case of rates for women, an attempt has

probably to be made so to adjust women's wages to men's wages, as not to offer any strong inducement to employers to substitute either women for men or men for women.

In view of all these conflicting considerations and possibilities, it must be obvious to everyone that only a body of supermen could fix wages which would be absolutely fair to all parties concerned. A Trade Board is probably justified in considering that it has done its work well if it is able to reach a settlement which is acceptable to a majority of the employers and workers in the trade. Experience seems to show that even a proposal which has met with strong opposition inside a Board may meet with a fairly good reception from employers and workers outside the Board. This provides at least some comfort to the "appointed members" when they are obliged to vote.

IV

In conclusion, it may be asked whether or not a great extension of the system of fixing legal minimum wages is desirable. Some would undoubtedly prefer to restrict the system to "sweated" industries, but as the Minister of Labour is busily engaged in extending the system, it hardly seems the best moment to discuss on first principles whether the policy is wise or not. For the time being, we have to accept the large increase in the number of trades covered by Trade Boards as an accomplished fact. In another year or two, enough information concerning the working of the new Trade Boards may be available to enable a fairly reliable opinion to be formed as to the wisdom of the policy. But one thing seems fairly certain: a very wide or universal extension of the system of legal minimum wages, though it may lead to the removal of some wages anomalies, will not prove a panacea for the most serious economic ills from which we are at present suffering. If the money incomes of the whole, or of the great bulk, of the population were doubled to-morrow, nobody would be any better off, as the real income of the country, the goods and services available for purchase, would remain unchanged. If increased money incomes were secured for a small section of the community, then the position of that section would be improved—at the expense of the rest of the community. If the object is to benefit the great bulk, or the whole, of the community, the fundamental problem is how to increase the national output of goods and services, which constitute the real income of the country. Without this, no rise in the general standard of living would appear to be possible. Whether a wide extension of Trade Boards can help in increasing the national output experience alone can show.

Temporary Stars

By Donald W. Horner, F.R.A.S.

THE recent discovery by Mr. W. F. Denning, F.R.A.S., of Bristol, on August 20, 1920, of a new star in the constellation of Cygnus has caused some unusual interest to be taken in novæ in general, and Nova Cygni in particular, so that it may be well to give a short résumé of the matter in the pages of DISCOVERY.

The new star discovered this year by Mr. Denning was at that time in the northern region of Cygnus, at R.A.[1] 19h. 56m. 24s. and declination N. 53° 24'. The star, which was when first seen about 3½ magnitude, was increasing in brightness, and reached a maximum on August 24, when it was of the 1·8 magnitude,[2] as observed at the Royal Observatory, Greenwich. A decline in lustre then occurred, so that by the end of August the magnitude was only 4¼, and by September 14 it had fallen to 5½, and was only faintly visible to the naked eye.

It is still being observed at the time of writing (October 1920) at all the chief observatories in England and abroad, and has aroused a remarkable extent of interest. In the years of the future it will continue to be examined as a small telescopic star, or possibly a nebula, for some of these novæ apparently display a nebulous appearance in their later stages.

New stars shone out in Cygnus on two occasions in past history, namely in August 1600 and in November 1876.

It is interesting to recall in this connection that the first authenticated appearance of a new, or temporary, star was in 134 B.C., and this star is said to have burst out quite suddenly in the heavens with a brilliancy sufficient to render it visible in broad daylight.

This star attracted the attention of Hipparchus, and caused him to make a catalogue of the stars (the first of its kind), with the object of enabling future astronomers to trace with ease and certainty subsequent apparitions of new stars.

In ancient times there seems to have been some confusion existing in the minds of the astronomers of those days between new stars and comets, and sometimes an appearance of the former object is mentioned when it is fairly obvious that the latter was the actual phenomenon witnessed.

It seems reasonably certain, however, that the apparition of 134 B.C., and also a new star which appeared in the constellation of Cassiopeia in 1572, were really novæ and not comets. The latter star would

[1] Right Ascension.

[2] The numbers expressing magnitudes decrease as the magnitude of the star increases.

appear the most remarkable of its kind that has been put on record.

On November 11, 1572, the day it was first discovered by Tycho Brahe, its brightness was as great as that of Sirius, and it rapidly increased until it was brighter than Jupiter, and soon became visible in the daytime. After this, however, it gradually faded away and disappeared after a lapse of sixteen months.

Coming to modern times, the most notable new stars previous to the recent discovery of Mr. Denning was Nova Aurigæ, discovered by Dr. Thos. D. Anderson, of Edinburgh, in 1892; and Nova Persei, which was first discovered by the same astronomer on the morning of February 22, 1901, and later in the evening of the same day by Mr. Ivor Gregg and Dr. J. Ellard Gore.

There are many theories to account for these sudden outbursts in space, of which perhaps the best known is that of Prof. A. W. Bickerton, which is known as the *Grazing Contact Theory* or the *Theory of the Third Body*.

In this theory the origin of the new star is said to be that the innumerable bodies forming the stars of the Milky Way travel in two great streams in opposite directions, and from time to time two of these suns meet with an appulse or grazing collision, pieces of the colliding stars being torn off, and, becoming explosively hot, coalesce into a new and third body of great brilliance, which makes what we call the new star, and the two colliding suns pass on their way.

What seems most extraordinary to the uninitiated is the fact that the collision, or whatever it may be that caused the outburst which we see as a new star, probably occurred some hundred or even two hundred years previously, the light of the mighty explosion having taken that interval of time to cross space even at the tremendous speed of 186,330 miles per second, or about 670,000,000 miles an hour. From this we see that an appulse of two suns may be now taking place in the region of the Galaxy which will not be viewed by either the present generation or the next.

The part of Prof. Bickerton's theory which assumes two great opposing streams of stars in the Milky Way has been confirmed by the observations of Prof. Kapteyn and other distinguished astronomers, but the portion dealing with the grazing contact of two suns still awaits substantiation. It was the new star which flashed out suddenly in Corona Borealis in 1866, and which was called the "blaze star," that led to the investigation of these phenomena; and it would seem that in most cases of this kind the "new stars" are mainly due to the revival from some unknown cause of a star already existing in space.

It is of course not necessary, if we accept the grazing contact theory, to bind ourselves down to appulses of solid bodies; the temporary star might equally well be due to a collision between a star and a nebula, or even between two nebulæ.

It may occur to some readers that if it be possible for collisions to take place in space it might one day happen that our own Sun would meet with an appulse from some unknown and possibly dark body. This contingency has not been overlooked by astronomers, but it has been found that whilst the suns in the region of the Galaxy lie in comparatively close juxtaposition there are no suns lying in close proximity to our own luminary. The late Mr. J. Ellard Gore, F.R.A.S., calculated that the chances against our Sun colliding with another body in space was 15,000,000 to 1, so that we need hardly fear the possibility of ourselves making a "temporary star" for the benefit of possible astronomers in another system in space!

The Hieroglyphs of Central America

By Lewis Spence, F.R.A.I.

Author of "The Civilisation of Ancient Mexico," "Myths of Mexico and Peru," etc.

THE strange system of writing anciently in use among the civilised peoples of Central America has not succeeded in attracting the same degree of popular interest in this country as the scripts of Egypt or Assyria, yet its claims upon the imagination are, perhaps, no less strong than those of hieroglyphic or cuneiform. Our grandfathers waxed enthusiastic over the amateur explorations of Stephens among the crumbling cities of Yucatan and Chiapas, but although the governments of the United States, France, and Germany have freely encouraged research in American archæology and its cultivation flourishes abroad, it still languishes among us. It is regrettable that British readers should remain unfamiliar with results so surprising and so creditable to human perseverance as those which have recently attended the discovery of the general purport of the Maya glyphic system. For the pursuit of this quest a far greater degree of effort and a higher ingenuity have been needful than was the case in the unriddling of the ancient writings of Egypt or Sumeria. That the quaint symbols of the ancient Maya have so far met with only partial inter-

pretation is, perhaps, one of the reasons why they fail to excite more general interest. But surely the privilege of watching the gradual revelation of these obscure glyphs is one on which our generation should

Tablet of Maya writing from a temple at Palenque.

place a higher value than it appears to think the opportunity merits.

The localities of Central America in which monuments bearing the involved and fantastic characters of this script are most generally found are still inhabited by people of that Maya stock who once employed it. They embrace the remote peninsula of Yucatan, the uplands of Guatemala, and the districts of Tabasco, Chiapas, and even a portion of Honduras. But by far the greater number of inscriptions have been met with in the southern part of these provinces, where the older branch of the Maya civilisation originally flourished. It is at such sites as Copan in Honduras, Quirigua and Tikal in Guatemala, and Piedras Negras and Palenque in Chiapas that important texts are found, rather than in Yucatan proper, although inscriptions of moment are not wanting at Uxmal, Chichen Itza, and elsewhere in the northern spheres of Maya influence.

Just as the ancient writings of the Middle East are found inscribed on a variety of objects, so the Maya script is not only painted on paper or skin or carved on stone, but incised on wood, bone, shell, metal, and modelled on pottery. The mediums of stone and paper were the most popular among the Maya scribes, and all others may be dismissed from our consideration. The carven inscriptions usually occur upon the sides of monoliths known as stele-shafts, which in shape, if not in their wealth of ornamental detail, recall the menhirs of Brittany. On altars, staircases, and frequently on the walls of temples and palaces, they are to be found nestling among the florid reliefs typical of Maya architecture. But the writing proper is confined to the few manuscripts or codices rescued from the pious attentions of the early Spanish ecclesiastical authorities and now in European museums or libraries.

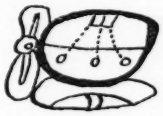
The shape of the glyphs or symbols as they occur in the carven examples differs somewhat from that employed in the written character, the former being adapted to the restrictions of the sculptor's chisel, the latter to the less limited technique of the scribe's brush. But the basic likeness between the forms is plainly apparent. At first sight the glyphs appear as a number of small squares rounded at the corners, representing human faces and other objects, highly conventionalised by generations of artistic usage. They have been described as " calculiform," or pebble-shaped, from the fact that the contour which encloses each of them resembles that of a small pebble. In this they are contained much as the hieroglyphs which make up the name of an Egyptian king are enclosed in a " cartouche," or oval contour. They are arranged in parallel columns, which are to be read two columns at a time, beginning with the uppermost glyph in the left-hand division. The reader must then work his way from left to right and top to bottom, ending with the lowest glyph in the second column. But should the glyphs be disposed in a horizontal band, the order of reading is from left to right, in pairs.

The history of the prolonged endeavour to discover

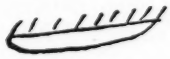
the hidden meaning of these characters so obstinately dumb, although one of continuous and patient effort, is not devoid of romantic quality, and has, indeed, furnished more than one novelist with material for a tale of absorbing interest. In 1565 Landa, Bishop of Chiapas, who destroyed a large number of manuscripts on the plea that they were " the devil's picture-books,"

The sign which means "sun."

The symbol for "moon."



"The spring equinox."



"Feather," the sign of the plural.

seems to have been smitten with a late compunction for his short-sighted policy, and addressed himself to the task of collecting all available information regarding the Maya writing from the native scribes who still practised it. He brought together a number of characters representing twenty-seven sounds, and the essay in which he preserved these was published by the enthusiastic but visionary Abbé Brasseur de Bourbourg at Paris in 1864, when French interest in Mexico was at its height. Landa's " alphabet " was at once hailed by Americanists as the key which would unlock the secrets of the Maya writing, the " Rosetta Stone " of America. But it was soon found that all attempts to decipher the glyphs by its agency were only partially successful, and it has been conjectured that the Indian scribes, who looked upon the bishop as the ruthless destroyer of their ancient records, purposely misled him. At the same time most of the names and symbols for the days and months as furnished by him are known to be correct, as is found by a comparison of them with the glyphs appearing in certain native books known as the Books of Chilan Balam, where they are shown with their phonetic equivalents in European letters.

The serpent symbol for "water."

Sacrificial victim.

This symbol is read, "Day of the new year in the month."

"Wind."

In 1876 the French Americanist, Leon de Rosny, published an alphabet of twenty-nine letters with numerous variants. But neither this, nor the attempt of another French savant, De Charencey, can be taken seriously. Ten years later Dr. Augustus Le Plongeon published *An Ancient Mayan Hieratic Alphabet according to Mural Inscriptions*. This, the most fantastic of the attempts to probe the mystery of the Maya symbols, compared and even identified them with those of Egypt, and did incalculable mischief in spreading the delusion that they had at last been deciphered, and were to be regarded as the prototypes of the Egyptian hieroglyphs. Most of Le Plongeon's " characters " are either ornamental details or bizarre inventions, unrepresented among the Maya glyphs.

The first student to throw any light on the manner in which the quest should be conducted if final success were to be hoped for was Professor Ernst Förstemann, of Dresden, who, about 1880, showed that the native records and inscriptions were chiefly concerned with the fixation of calendric festivals and the dating of monuments. He discovered and elucidated the elaborate and ingenious system of numeration in use among the peoples of ancient Central America, and showed how it was utilised to record astronomical and chronological facts. In short, his pioneer work made possible all subsequent progress in deciphering the texts. Curiously enough, an American student of the subject, Mr. J. T. Goodman, of Alameda, California, working independently, arrived at conclusions similar to those reached by Förstemann. Since that time the work has been carried on by the late Professor D. G. Brinton, of the University of Pennsylvania, Professor Eduard Seler, of Berlin, Mr. S. G. Morley, and, notably, by Mr. C. P. Bowditch, of Boston, who, by addressing himself to the task of placing the whole study on a systematic basis, has made it possible to survey the entire field of past endeavour and has rendered further progress practicable.

Judging from the complete state of development at which the system had arrived at the date of the discovery of Central America by the Spaniards, there is every reason to refer its origin to a past of consider-

able antiquity. As the late Dr. F. W. Hodges, of the Bureau of American Ethnology, remarked: "The earliest inscriptions now extant probably date from about the beginning of the Christian era, but such is the complexity of the glyphs and subject-matter, even at this early period, that, in order to estimate the age of the system, it is necessary to postulate a far greater antiquity for its origin. Indeed, all that can be safely accepted in this direction is that many centuries must have elapsed before the Maya hieroglyphic writing could have been developed to the highly complex stage where we first encounter it."

A brief examination of any Maya text reveals the presence of certain elements which occur repeatedly in the glyphs, but in varying combinations. Two or three small but separate signs frequently go to the making of each glyph. So numerous are the combinations and permutations of these, however, that the student might at first sight suppose that a great number of signs were employed in Maya writing. But closer observation will convince him that these elementary symbols are in reality few in number. His difficulty lies in identifying them and gaining experience of the different forms they take. In Egyptian texts the simple phonetic signs are unchanging under all circumstances of composition. Like the letters of our alphabet, they never vary, and may be recognised as unfailingly. But in the Maya texts the normal form of the element may be altered for reasons of space, individual peculiarities of style, or artistic symmetry. It has been ascertained, however, that each glyph holds one essential element, which was seldom altered, and that it is only in the case of accessory or supplementary elements that any great variation was permissible. But it is rare to find two glyphs which have the same meaning and the same elements precisely alike in drawing, contour, and general appearance. It is as if the letters of our alphabet were not standardised in form, but were subject to the caprice of each individual writer or printer. Such dissimilarities are often due to differences in the materials in which the glyphs are delineated, as well as to careless drawing and actual mistakes—for errors, and those not a few, have been encountered both in examples of the numeral system and the writing proper. These conditions render progress slow and results uncertain.

Sometimes the pebble-shaped outline or "cartouche" of a glyph is altered to a "head-shape"; that is, the customary form is changed to the contour of a human head. The symbols usually confined to the outline are transferred to this "head-shape," or cunningly adapted to its physiognomy in a manner which speaks volumes for the artistic ability of the Maya sculptors and scribes. These "head-variants," as they are called, are puzzling enough when the meaning of a glyph in its original form is already known. When it is unknown, they are baffling indeed.

The glyphs as a whole have been divided into two groups: astronomical, calendric, and numerical signs (that is, glyphs used in counting time), and those having an explanatory function of some sort. The great majority of the symbols already deciphered belong to the first group. The second, which is much the smaller, in all probability relates the facts of Maya history.

As regards the question whether the system is phonetic or pictorial in character, much difference of opinion exists. Three principal theories have been advanced to account for the nature of the Maya writing. Some authorities believe the glyphs to be phonetic, each representing a fixed sound and entirely dissociated from the presentation of any thought or idea. Others regard them as ideographic, each representing in itself some complete idea or conception, while a third school supposes them to partake of the nature of both types. It is obvious that the first theory cannot be accepted in its entirety. The glyphs unquestionably show traces of phoneticism, but all attempts to reduce them to a phonetic system or alphabet have signally failed.

The theory that they are ideographic has a larger following. But Brinton pointed out that a native writer was able to give Landa a written character for an unfamiliar sound (as, for example, that of a Spanish letter), and that the characters the Maya scribe employed for this purpose were certainly used in the native writings. These facts led Brinton to think that some sort of phonetic writing was not unknown to the Maya; and, indeed, both the inscriptions and the manuscripts establish the soundness of this contention.

As we have seen, the phonetic sounds of certain glyphs relating to days and months are known from Landa's work, in which they are accompanied by their Maya names in European letters. In these, at least, he was not mistaken, as we glean from certain native manuscripts which record the names of the glyphs for the days and months in the same manner. One, for example, is known as yax, a picture of a tree-stump, which means "region" or "place." Another is kin, "sun," and when these symbols are combined, they are known as yaxkin, "sun-region," or "warm region"—"the south." Similarly, the character representing the phonetic value kin is also found as an element for the words likin, "east," and chikin," "west," each of which has kin as its last syllable. These elements are thus manifestly phonetic. But this notwithstanding, the glyphs alluded to have meanings quite independent of their mere phonetic values. Primarily, their function is to convey the ideas of

"sun" and "region," and they were used phonetically in a secondary manner only.

Such glyphs as are phonetic, it must be clear, rank not as letters, but as syllables. This kind of writing Brinton called ikonomatic, or rebus-writing—a script

The sign for the year.

The sign for "beginning."

"The end."

in which the characters do not indicate the meaning of the objects which they portray, but only the sounds of their names. Let us suppose, if the reader will pardon the homeliness of the illustration, that we draw pictures of a human eye, a can, a bear, a cobbler's awl, the numeral 4 and a ewe, and translate the rebus "I can bear all for you." In such a system the first picture is intended to recall not the idea "eye," but the *sound* of the word denoting the object, which is also that for the personal pronoun I. Again, the picture of a bear does not represent the idea of that animal, but stands for the sound of its name. Such a method is occasionally employed in the Maya writing, especially, thinks Mr. Bowditch, in the case of common nouns and abstract ideas. The writing in use among the Aztecs of Mexico was, indeed, entirely of this character, and it is believed that they drew inspiration from Maya sources at an early period.

The crux of the whole question, indeed, is: How far do phonetic elements enter into the composition of the Maya glyphs? It seems probable that as the decipherment of Maya writing progresses, an ever-increasing number of phonetic elements will be identified, though the idea of a glyph will always be found to overshadow its phonetic value. That is, in the consciousness of those who employed it, the system would, through generations of usage, come to possess a significance chiefly ideographic,[1] and it would not necessitate any such effort of mental translation as a people unused to rebus-writing would have to make to comprehend it readily.

[1] That is, each complete glyph would bear a fixed meaning.

At an early stage in his researches Förstemann discovered the sign for zero or nought (a shell), which was derived from the symbol for "completeness," zero being regarded as the only complete or perfect number, incapable of division or multiplication. He was also able to show that the symbol for the moon (a cursive form of the head of the moon god), represented the Maya "month" of twenty days, the period in which the moon waxes and wanes, and therefore the number 20. It was readily found that a dot stood for the numeral one, from the analogy of the Mexican manuscripts, in which the days of the month are numbered in their proper sequence by dots, and from the same source it was gleaned that a bar or dash represented five, a bar and one dot six, two bars ten, and so forth. But the manner in which the "higher mathematics" and system of dating of the Maya were elucidated is much too involved a process to be described in a popular article, and some account of the way in which a few of the more useful glyphs were identified will, doubtless, prove of greater interest to the reader.

Förstemann recognised from Landa's work that one of the signs for a certain day of the Maya month is called akbal, which means "night," and that the sign had the same significance and phonetic value as a glyph was suggested by the star-like dots which surround it. Now akbal is used as a day-sign because it also means "the beginning of the month," the Maya month commencing immediately after midnight. Therefore, when he found the sign akbal as an element of a glyph and observed footsteps painted beneath it, Förstemann translated it as "beginning" or "forward movement." He found, too, that a glyph representing the number seven, which in Maya has the significance of "great" or "ultimate," means "the end." From the frequent contrast of these terms there can be little

"Tying together," "union."

"Division" is symbolised by a flint knife.

The sign for "might" and "sky. The dots represent stars.

doubt that their significance is what he assumed it to be.

"Union" is denoted by the sting of a rattlesnake, the coils of that reptile appearing to the Maya as symbolical of "tying together." We have here the idea of representing the whole by the part, which is also to be remarked in the glyph for "dog," which is merely a drawing of the ear of that animal. In contrast to the sign of "union" is that for "division" or "cutting," which is represented by an obsidian knife. A half-closed hand means "to eat," derived from the action by which one raises food to the mouth. Added to the kin or "sun" sign it denotes chikin, "the west," probably from the circumstance that the Maya took their principal meal at the hour of sunset. Likin, "the east," is a combination of the sun-sign kin and the symbol for "king" (ahau), which is derived from a root meaning "to rise up," "to awake," so that the whole implies "the sun awakes," "the sun rises." Xaman, the north, is more directly symbolised by the face of the devouring earth-monster, which was supposed to dwell in that region.

The figure denoting the spring equinox was traced because of its obvious representation of a cloud from which three streams of water are falling upon the earth. A square portion at the top represents the sky. The obsidian knife underneath denotes a division or period of time cut off, as it were, from other periods of the year. That the sign means "spring" is verified by its position among the other signs of the seasons.

Water is depicted by the figure of a serpent, which typifies the undulating nature of that element. The symbol known as "the sacrificial victim" is pictorially eloquent of its subject. Its first element is the vulture or death-bird, and the second shows a crouching and beaten captive, ready to be immolated to one of the terrible Maya deities whose horrid rites included human sacrifice.

The symbol signifying "the day of the new year," which occurred in the month Ceh, is composed of elements meaning "sun" or "day," "year," the sign for "division," and that for the month Ceh, the whole thus signifying "the day in which the year is separated in the month Ceh." The symbol for "wind" has also been determined from its accompaniment by a figure known to be a deity of the four cardinal points, whence all American tribes believed the wind to come.

Other glyphs identified relate to various colours, including red, yellow, white, and black, the names of certain deities and those of several planets, Venus and Mercury among them.

It is clear from what has been established that the texts are chiefly concerned with the fixation of religious festivals. But there is a residuum of matter which undoubtedly relates to historical occurrences of outstanding importance, to which the accompanying dates refer. What may these still obscure symbols not conceal? So much can be said, that what they have to disclose will make terse reading, for the signs in which the precious information is latent are few. But so highly concentrated is the syllabic script of the ingenious Maya scribes, that such of it as remains dark to us may contain more of value than we suspect.

Ocean Currents[1]

By P. J. Harwood

THE present article aims to present the subject of Ocean Currents in a more definite light than has hitherto been the case. There seems at present to be no conclusive synthesis of the causes which operate to produce these phenomena, and for lack of such, we find conflicting testimonies and opinions, and, in general, inadequate and hesitating treatment, which must leave this subject in obscurity and confusion for anyone who seeks to do justice to this important branch of geographical study.

A current is dependent on the fluid nature which water possesses. It is the result of an impulse to movement where the lines of action are confined to particular portions of any body of water. Since an ocean of water is a homogeneous whole, it will follow that any disturbance made in one part will find a reaction in the remaining parts. Of all the modes of application whereby the impulse to movement can become, it is necessary to choose those which have the deeper foundations of action, and these are not necessarily those which are known and seen to have an effect disposing to the ultimate end.

A current may be produced in a variety of ways; for instance, when a pool of water is continually stirred by a stick in the same direction; when, with puffs of breath the water may be made to circulate in a basin; or, when under the action of gravity, a whirlpool is formed around the orifice of an outlet such as we see when water is emptying from a bath; and lastly, the much-referred-to convection currents, which are caused by differences of temperature in various parts of the liquid.

[1] This article should be read with an atlas before the reader.—ED.

Examining first the question of currents by convection, we observe :

(1) The heat of the sun is applied from above ; the surface water is therefore subject to most heat. As heated water is expanded and is therefore lightened, there will, from this cause, be no tendency for the surface water to change places with the lower water, as would be the case if the heat were applied from below. But, as against this, is the fact that ocean water contains a fair proportion of salt, which gives a Specific Gravity of, roughly, 1·027, i.e. for every 1,000 ozs. of pure water which it contains there are 27 ozs. of salt. The effect of heat in the Tropics on the salt water will be to evaporate the pure water, leaving the residuum with greater saltness. From this cause the surface water will become the heavier and, consequently, will sink. Whatever is the resultant in these two opposite cases, the motion will be vertical, and as such would bear little relation to the great horizontal currents which we are considering.

(2) There is, next, the condition of the unequal heating of the surface waters of the globe, due to the respective positions relative to the Equator and the Poles. Regarded as the primitive and sole cause for the great ocean currents, the components contained in these conditions are insufficient to account for the necessary displacements. Gravity can have no *direct* effect in drawing polar water to the Equator, and equatorial water to the Poles. And here also there arise as in (1) two complementary and opposite sets of conditions ; viz. (*a*) that cold, pure water is heavier than warm, pure water ; and (*b*) that much of the cold water of the Arctic oceans will be pure owing to the melting of glaciers and icebergs which, being frozen pure water, will, when melted, be of less specific gravity than the salt water of the oceans. This latter, (*b*), may, however, be of trifling consideration when the vast ocean waters are being considered. If the Arctic oceans are heavier than the equatorial, then the action would naturally be of a creeping or sliding—i.e. indirect—nature, the warmer water from the Equator remaining on the surface. But this creeping in folds in broad stretches from north to south and south to north, is not in accordance with the definite cyclic movement which takes place in the ocean, and therefore this influence of itself fails to account for the phenomena. Regarded, however, as a secondary influence in the operation of currents, the idea of differences of specific gravity from temperature may be considerable. For instance, if a cold current (caused by other influences) meets a warm current, there may at once be displacements in which the colder water will sink and the warmer water rise. This seems to be the case with the Gulf Stream and Labrador currents.

(3) Considering next the question of prevailing winds as causes of the ocean currents, we find here a considerable correspondence between the two, and, because wind can influence the surface flow of water, it has been inferred that the winds are the causes of the ocean currents. This, however, does not necessarily follow ; the very fact that these two fluids, the atmosphere of the earth and the water of the earth, have corresponding motions, may simply indicate that they are susceptible to the same cause or causes. The more freely moving air may then, by friction, accentuate the slower, tardier, movement of the ocean. There is, however, an example in which the action of the wind, among the factors which operate in the causation of currents, seems to be predominant. Against the normal flow we find that the north equatorial current of the Indian Ocean is changed in its direction from west to east under the influence of the Summer Monsoon. It is probable, however, that all wind action is very superficial.

The fundamental action on which all currents depend for their prime initiation can without hesitation, because of the strong evidences which arise to support it, be ascribed to the rotation of the earth. Questions of temperature, the action of winds, etc., sink into insignificance compared with the essential cause which is found in rotation. These are but modifying factors of the main factor. The rotation of the earth is the backbone of oceanic circulation.

The rotation of the earth represents a movement round a fixed axis. In this movement, the solid earth, the waters of the ocean and the gases of the atmosphere, all take part. But, whereas the solid crust of the earth is rigid and a constant relation of its parts to one another is kept up, on the other hand, the atmosphere and the oceans being fluid, movements of considerable magnitude are constantly going on within themselves, while as a whole they rotate. But also, in the actual rotation of the solid parts and the fluid parts of the earth, there is not a strict relation and fixity of action. Consider what happens if a tank of water is pushed violently away. The tank moves—the whole of it ; the water, however, slops over towards the side pushed. Relatively to the tank only, the water moves in a direction opposite to the tank. Two main factors are accountable for this. First, there is the inertia of the water which gives it a quality or tendency to remain where it was—the tank also had inertia. Secondly, it possesses the quality of fluidity wherewith, partly, its inertia can escape the effects of the push. In other words, owing to its lack of rigidity the push is not conveyed " end on " throughout the particles of the liquid. The condition of the earth is similar to this. In its rotation the waters of the ocean do not keep pace with the solid crust ; they lag behind. While, therefore, the rotation is from west to east,

owing to the difference of speeds a relation arises in which, compared with the solid earth, the oceans appear to move from east to west.

It is to be noticed, further, that the surface water in the tank tends most to " slop over." This is not only because the surface water is nearest the edge of the tank, but also because it enjoys a greater freedom of movement than the under water. In the case of the under water an extra condition is imposed by the fact that it is kept down by the weight of the water above it. Thus it is *constrained* to a greater degree than the surface water, and thence it is invested with a certain rigidity or immovableness. For, acting in conjunction with the downward pressure from above is the rigidity forced upon it by the presence of the walls of the tank, which prevent its motion outwards and by resistance hold it back. In other words, the lower portion of water is *encased* by inwardly directed force pressures on all sides around. This does not occur to the same extent in the case of the surface water, which, even though the tank walls extend to a height above it, can find a freedom of movement by splashing upwards, no weight of water being above it to press it down. Applying this conception to the magnified conditions of the oceans, where in some cases the height of the waters above the floor-bed is measured in miles, the gigantic pressures which must necessarily result in the lower deeps, will confer on the liquid water an immense rigidity, and by the enormous weight above, a frictional grasp of the surface of the rigid earth crust beneath the waters, as will cause them to be rotated with the solid earth almost entire. This rigidity, as will be seen, will diminish as the free surface of the water is approached. Corresponding to the sides of the tank are the raised parts of the ocean bed rising to dry land, and it is these which keep the waters *in*, while the gently sloping shores of the land offer that minimum of resistance as would allow the extreme surface movement of the waters over them, resulting from their slipping back from the main movement of the earth. Hence, in the consideration of ocean currents, we arrive at the natural condition that such currents will be mainly *surface* currents, and will not materially extend to the great depths of the oceans. The greatest depths of ocean currents are supposed not to be more than about 1,600 feet, or, roughly, one-third of a mile.

When any homogeneous rigid body is rotated it is necessary, in order to prevent strain, for the outer layers to move at a greater speed than the inner or more central portions. Similarly, in a globe where the axis of rotation is a diameter, it is necessary for the polar layers, which are nearer to the central axis than the equatorial surface layers, to rotate at a slower speed than the latter. This occurs in the rigid body, the earth. In one rotation, a point on the Equator is carried 25,000 miles; a position in Lat. 40, 19,250 miles; at the Poles the distance of rotation becomes infinitely small. Thus, there is a graduating speed from Equator to Poles, the equatorial region being moved the fastest, viz. 25,000 ÷ 24, or 1,100 miles per hour.

According to the speed at which the solid earth and the waters above it are travelling, so the lag of inertia in the waters will have effect. At the Equator, therefore, the lag will be most pronounced, and the current there formed will be the main current of the world to which all lesser currents must subserve. If the earth is imagined entirely covered with water of uniform depth, we should then have a main ridge current round the Equator performing a continual circle of movement from east to west. On either side of this will be lesser currents. All these waters of the earth would wash round in a direction opposite to the direction of rotation of the earth, and these currents would be parallel to the Equator, and they would move at different speeds, but the resultant movement with the solid earth will be of rotation in the same direction. The lag of the currents, it might be pointed out, will, by the friction caused, tend to create a " brake action " on the earth's rotation, similar to that of the tides hypothesised by Kant; but complementary action arises to nullify this.

Looking at the map of the world, we find the ideal case above very much modified, but the intrinsic nature is not blotted out. Both in the Pacific and the Atlantic the north and south equatorial currents form the main feature. Instead of an ocean of uniform depth enveloping the earth, land masses arise between, and by their interception break up the continuous oceanic circulation above hypothesised. It is evident that the flow continues until land is approached, and, a collision taking place, the current is laterally deflected on either side, so that one branch flows north and the other south, the while continuing to exert their western tendency, as is seen by the " hugging " of the eastern shores of the continent approached. This throwing of the waters to the west is clearly seen, not only in the equatorial regions but in the regions approaching the Poles. The Labrador Current, the East Greenland Current, the Oya Siwo of East Siberia, are examples of this, though, as we shall see, the equatorial direction also enters in to cause that same hugging of the eastern shores. Thus, *Land Masses* become an important factor in the question of Ocean Currents; and though they do not originate the causes of flow, they enter as modifying agencies in disposing the final form of the complete currents.

(*To be continued*)

Reviews of Books

The Idea of Progress. By J. B. BURY. (Macmillan, 1920, 14s. net.)

It is a sign of the times that we discuss fundamentals; and of these fundamentals, the idea of progress has perhaps come in for the most searching criticism of all. We have had Bertrand Russell with his despairing yet glorious belief in the Promethean destiny of man. We have had Mr. Marvin and his band of optimistic essayists. We have had the Dean of St. Paul's, who, in his Romanes Lecture of this year, turned the doctrine of man as the cosmic rebel, so startlingly enunciated in the same building a quarter of a century ago by Huxley, into a strange blend of Christian hope and evolutionary pessimism. Now we have the most solid of recent contributions, in the shape of this volume of Professor Bury's.

The work is of the greatest value; for it is the first attempt, since the Darwinian epoch and the subsequent reaction, to give a connected and critical account of the history of the idea of progress.

So long as men were content to translate their own desires into a creed, so long as they cherished apocalyptic hopes, so long were they inevitably unable to frame an idea of progress which should not be too remote from reality. Only by a historical survey can they see what has failed, can they see why it has failed.

The most important and at the same time the most startling point here brought out is that the idea of progress as we know it, and indeed in any significant sense, was never grasped in antiquity, nor in the Middle Ages, and in fact did not germinate until the seventeenth century. The idea of progress excludes the doctrine of a Golden Age; it excludes the notion of inevitably-recurring cycles; it excludes the veneration of antiquity; it excludes belief in an immediate coming of the Kingdom of God, or, indeed, of any "illusion of finality"; it excludes real pessimism and genuine individualism; it excludes excessive "next-worldliness," as of the early Fathers. One or other of these ideas was dominant in civilised thought until the Renaissance; and it was not until the Renaissance had accomplished its work of destruction, had proceeded to construction, and had overcome its early emotions of self-complacency, that the idea of progress could be born, or at least before it could exercise any general effect upon human thought.

Dean Inge laid stress upon the progress caused by Christianity's introduction of the idea of Hope as a living force. Bury emphasises the close connection between the rise of the scientific habit of mind and of the true idea of progress. He traces it up from its genesis as a historical principle in the writings of Bodin; shows how Bacon first coupled it with the double team of Utility and Knowledge; how the eighteenth century's optimism expanded it from a limited and verifiable principle into a universal and unverifiable dogma; how the scientific spirit began to criticise this dogma, and to search for a law of progress

[*Continued on p.* 378

T. Fisher Unwin's Books

A NATURALIST ON LAKE VICTORIA. With an Account of Sleeping Sickness and the Tse-tse Fly. By G. D. HALE CARPENTER, D.M., B.Ch. (Oxon). Fully Illustrated. Cloth, 28s. net.

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THE JOHNSON CLUB PAPERS, 1920. By Various Hands. Edited by GEORGE WHALE and JOHN SARGEAUNT. Cloth, 10s. 6d. net.

This volume includes contributions from, among others, Edward Clodd, Sir George Radford, A. B. Walkley, and H. B. Wheatley.

CHATS ON OLD SHEFFIELD PLATE. By ARTHUR HAYDEN, Author of "Chats on Old Silver," etc. Profusely illustrated. Cloth, 21s. net.

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which, like any other scientific law, should be but an epitome of observed fact; how the genius of Darwin inevitably made the question of human progress but part of a greater question, that of organic and indeed of cosmic progress; and then, in the epilogue, strangely enough, he turns to contemplate with calm the possible future dethronement of the idea of progress and its replacement by some other guiding principle.

Too high praise cannot be given to the book. The style, the range of quotation, the method and the argument, all conspire to render it invaluable to the historian, the philosopher, and the scientist, and not to be missed by the general reader. A few quotations may be allowed before we pass to criticism. The idea of progress involves advance "in a definite and desirable direction." "The principle of duty to posterity is a direct corollary of the idea of progress." "The idea of the Progress of Humanity raises a definite question of fact." "The doctrine of original sin is an insuperable obstacle to the moral amelioration of the race by any gradual process of development." ". . . For Comte, the coming society which he adumbrated was the final state of humanity." We would quote more, but space is limited.

The only important criticism to be passed upon the volume is that its author, in common with the Dean of St. Paul's, Bertrand Russell, and indeed most modern thinkers on the subject, pays no adequate attention to biological progress. This must be a corner-stone in any doctrine of progress; and its neglect can only be explained if we suppose that the biologist's reaction against evolutionary speculation still dominates lay speculation, and that the recent more hopeful and more constructive work has not yet percolated through to the lay mind.

It is impossible to discuss the matter here. We must be content with reminding our readers of one fact—namely, that if Evolution be a reality, man has been produced from unicellular organisms. This is a change in a "definite and desirable direction"; and the majority of, though not by any means all, evolutionary changes are in the same direction. It is common knowledge that all direction in evolution has not been upward; there has been degeneration, parasitism, over-specialisation. But the upper level attained by evolving life has steadily risen. Life as a whole has moved in a progressive direction—towards greater control of the external world, towards greater independence, towards greater internal harmony, and towards greater intensity of emotion. Not only this; but such changes have occurred in several separate evolutionary lines, and would have occurred even if man had never arisen.

Through biology, we are not only given the assurance that real progress has occurred, but are enabled to see what its type has been. Biological progress, real but imperfect, is a touchstone for the theories of human progress. The last step in evolutionary progress has been that man, himself a product of that process, has become aware of it. The next step will be that (if he choose to exert himself) he will, deliberately and of set purpose, bend himself to control, to refine, and to accelerate it.

J. S. HUXLEY.

Mental Tests in the American Army. Compiled and edited by C. S. YOAKUM and R. M. YERKES. (Sidgwick & Jackson, London, 6*s.* 6*d.*)

This is an important book primarily for psychologists and educationists, but also of great interest to everyone interested in examinations, more particularly those which go by the name of mental tests, and to the important deductions respecting the mentality of those examined which may be made. It deals, of course, with Americans and with an army that is past, but it would be a great mistake to neglect the book for these reasons. It is full of intellectual interest; it is also what one might describe as a very human book.

This book deals with a very important experiment. The Americans came into the war later than we did, and while we were busy in holding our own, they had time to think and to look round. They hit upon the idea of classifying their personnel in the army by mental tests, so that they might have at least some guide in placing their officers and men in the different units. We, on the other hand, had University professors frying bacon as mess-cooks merely because their spectacles prevented their being in the trenches, and, in many cases, a man with little more than the brain of a louse taking charge of highly technical and administrative work merely because he was of such-and-such a rank at the outbreak of war. Occasionally, and oftener towards the end of the war, the man and the job suited each other, and he could get ahead with his work unmolested by some dead-beat who happened to be a week senior in rank, or by unqualified assistants who had wandered in from nowhere.

The Americans had a better chance than ourselves to classify men. They were under no illusions that brains or cleverness, or whatever it is that was revealed by the mental tests, were the only things necessary to make the efficient soldier. But it was a very good way of sizing up people pending further inquiries, and there is no question that this method of classification was a success. The subject has already been discussed in DISCOVERY by Dr. Veazie.

This book gives a full description of the work of the men who organised the mental tests, carried out the examinations, and made the classifications and deductions from the results. The examination tests themselves are given in full detail, with a description of the conditions under which those examined were tested. The tests were of a very varied nature, designed to test intelligence, common sense, and resource rather than knowledge of facts; but we, who are not being examined, can see their human and at times their humorous side. A few only will strike English readers as being very American. Devotees of parlour games, lovers of guessing competitions and conundrums, will find abundant material here to make them happy.

Altogether a most illuminating and at the same time enjoyable book.

Handbook of Patent Law of All Countries. By W. P. THOMPSON. (Stevens & Sons, 6*s.*)

This is the eighteenth edition of a book that appeared originally fifteen years before the present writer was

born. Mr. Thompson has been a patent agent in Liverpool even longer than that. It is deduced, therefore, that the author knows very well what he is writing about, and the reviewer confirms this view. This book is the best synopsis of British Patent Law that has appeared. It tells anyone who wishes to take out a patent the best way in which he can secure one, not only in this country, but also (and this is often of great importance) in other countries. Much sound wisdom on the best kind of things to secure patents in and guidance on investing in patents is given, and the description of the large sums of money to be made from patents almost tempts one to give up reviewing for inventing. It seems so easy, and doubtless at times it is. The law is expounded for nearly all the countries in the world which have issued patent ordinances. The book is a valuable and trustworthy guide.

The Year Book of the Universities of the Empire, 1918–1920. Edited by W. H. DAWSON. (G. Bell & Sons, 15*s*. net.)

The new edition of this year-book, which has recently appeared, has brought the Third Edition (1916) right up to date, and careful examination and a frequent consultation of it have left the reviewer with no other opinion than that Mr. W. H. Dawson, who has edited this book, and the Committee of the Universities Bureau, who are responsible for its publication, are to be congratulated upon their work. It will find a place in all public libraries, and on the writing-table of the common-rooms of our colleges and universities, and, we hope, in the private possession of university men and of many of those who are interested in the universities of the Empire, their doings and their staffs.

What is this Year-Book? It is a conspectus (a good word!) of the calendars of all British universities both abroad and at home. It gives a condensed but authoritative version of the principal facts about universities—their courses, examinations, degrees; their buildings, laboratories, libraries; the numbers of their students, etc. It gives complete lists also of the teaching and administrative staffs, which, considering the difficulties in front of the compiler, reflect great credit upon his diligence and his skill. They are remarkably accurate. A book in which all the really important facts are either given wrongly or omitted altogether is always irritating; and that is why all but a few of the best reference books are suspect. It is even unpleasant to have one's own name or initials given wrongly in reference books. We are glad that care has made this book so accurate. There are one or two slight omissions to which we may call attention. The McCrea-Magee college in Derry, which is affiliated to Trinity College, Dublin, is not mentioned. Also all the Munros but one are referred to in the index as Mungo. Doubtless the printer was a Glasgow man! Of the men known to the reviewer whose names might have been included in the book, two alone are missing. One of these was appointed to Hong-Kong University, and the other moves so rapidly from university to university that, doubtless, he was in the train when the lists were compiled, and, like the hare in the story of the

[*Continued on p.* 380

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Harvard man and the sheep in the pen, was moving too quickly to be conveniently counted.

In the Empire at the present time there are nearly sixty properly-constituted universities. Nineteen of these are in Canada, nine in India, six in Australia, three in South Africa, and one each in New Zealand, Malta, and Hong-Kong. At home there are eighteen, excluding the unattached University Colleges: three being in Ireland, four in Scotland, and eleven in England and Wales. The days when Society and the fashionable press could admit the existence of Oxford, Cambridge, and Trinity College, Dublin, only are now happily over for ever. Most of the home universities of to-day are better in every way than were these fifty years ago—more alive, better equipped, more scientific in spirit, more humane in outlook. One may safely divide the eighteen by two, and talk now of the first nine universities of this country instead of the first (or only) three of 1870.

The university man will find the lists of professors and lecturers at the different universities the most frequently consulted part of the book. If not a Who's Who, it is at least a Who's Where of the brotherhood. It is hoped that the demand for this book may make possible a new edition annually, so that these valuable lists may be kept as up-to-date as possible.

A special feature of the present edition is the appendix, giving an account of war activities other than combatant which the home universities did. "So numerous and varied have these been, that it is impossible in looking back to picture the war as progressing towards a successful issue without them." An account is given also of the contribution to the forces of the universities overseas. A really excellent handbook. P. K. F.

Meteorology. By R. G. K. LEMPFERT, M.A., C.B.E. (Methuen & Co., 7*s.* 6*d.* net.)

One surmises that, in addition to those who owe an initial acquaintance with the broad principles of modern meteorology to the perusal of Mr. Lempfert's *Weather Science* (a brief but admirably clear outline of the subject), many who are naturally curious concerning the processes operating in the earth's atmosphere and manifesting themselves in weather phenomena will welcome this, the author's latest work.

Details of observational routine have been almost entirely omitted, and the author has concentrated upon a presentation of the main facts which have emerged, especially during the past two decades, as the consequence of organised exploration of the atmosphere by means of kites and balloons carrying autographic instruments. The information thus rendered available has effected a rapid, yet sound, development of the conceptions of atmospheric structure and circulation.

The early chapters are devoted to a consideration of the Weather Map (an increasingly powerful instrument in the hands of the forecaster in these days of radio-communication), an adequate treatment of wind, pressure, temperature, and the relation of wind to the distribution of pressure, a relation upon which depends so much of the superstructure of meteorological theory.

A discussion of the ascertained behaviour of surface air currents and a study of "line squalls" (those abrupt phenomena so disconcerting, even if not fraught with actual peril, to aircraft) conclude with a description of the thought-provoking views on the structure of moving cyclones advanced last year by Bjerknes, who, extending the scope of his original investigation, has formed the opinion that at least in temperate latitudes great weather changes are due to the interaction in a definite way between phalanxes of air from polar and equatorial regions.

But we feel that it is the latter half of the volume which will appeal most powerfully to those who are desirous of acquiring an insight into the present state of knowledge concerning parts of the earth's atmosphere which in recent years have become accessible to aviators, and, observationally, to meteorologists, by means of pilot and registering balloons.

The thermal processes of the atmosphere, the variation of wind with height, the relations between atmospheric circulation, temperature, and pressure in the upper levels, are dealt with in an illuminating way; while the author's exposition of the facts and theories concerning the stratosphere (the mysterious upper portion of the atmosphere), the deeper differences between anticyclones and cyclones, and the domination of the surface conditions by those which obtain at a certain high level, cannot fail to fascinate the reader.

The value of the book is enhanced by the incorporation of accounts of the most recent work in various branches of the subject. In addition to the investigation of Bjerknes, mention is made of G. I. Taylor's important theory of eddy-motion, with its several applications to phenomena associated with the surface layers of the atmosphere; and of the lately published determination of atmospheric composition at great heights by S. Chapman and E. A. Milne, who conclude that at heights above seventy-five miles the chief constituent is probably helium and not hydrogen, as has been usually believed.

There is frequent mention of the mutual relation and interaction between the war and meteorology. As a case in point, the author, after demonstrating how, from a knowledge of wind direction and speed in the upper levels, the distribution of pressure and temperature may be inferred, proceeds to deduce the conditions which gave rise to the unexpectedly strong northerly winds at heights above 10,000 feet on October 19, 1917, an occasion which proved catastrophic to a fleet of Zeppelin airships, which, after raiding S.E. England, was carried far to the south and scattered over France.

Whilst remembering that a work on meteorology must be inevitably of somewhat limited scope if it is to be kept within moderate dimensions, one has to confess to some slight disappointment that it was considered impossible or inadvisable to incorporate in the volume under notice a fuller treatment of physical processes associated with the formation of the various cloud forms, the interesting but complicated phenomena of thunderstorms, and, finally, a presentation of the information at present

available concerning the influence of solar activity upon the processes of the earth's atmosphere.

In comparison with some others, for example Germany, this country has been singularly lacking in meteorological books written by persons of authority, and for this reason, if for no other, one is glad to receive a work by an Assistant Director of the Meteorological Office.

This luminously expressed and, one may add, well-produced statement of the chief features of modern meteorological endeavour and thought requires no profound knowledge of mathematics or physics on the part of the reader, and will be of inestimable value to those who cannot readily gain access to official and other publications containing the detailed accounts of original investigations. Not less irresistibly will the book appeal to those who contemplate adopting, or who have recently adopted, the profession of meteorology, and, lastly, to all students of science, particularly of physics and mathematics, whose attention is normally not directed during a university career to the manifold problems of the atmosphere which await investigation and elucidation.

H. W. L. ABSALOM.

Studies in Fossil Botany. By D. H. SCOTT, D.Sc., F.R.S. Third Edition. Vol. I, Pteridophyta. (A. & C. Black, 1920, 25*s.* net.)

Dr. Scott's volumes on Fossil Botany are sufficiently well known to the botanical student as affording the readiest and clearest introduction to this branch of the science, and the fact that they hold the field is shown by the issue of successively enlarged editions. The work was originally published in one volume (1900), and increased to two volumes in 1908. The first part of the latter issue has now grown from 363 pages to 434, with an added selection of 66 new figures, or 190 in all. The earlier chapters follow the previous editions with comparatively little modification, including accounts of Equisetales, Sphenophyllales, and Lycopodiales of the Coal Measures, as derived more particularly from the examination of sections of coal-balls, in which details of anatomical structure are so clearly shown that one acquires a conception of the general organisation of these remarkable plants, almost as complete as if they were still alive. Many of these arborescent Calamites and Lepidodendra attained forest dimensions as 100-feet trees, and they are still visualised by the help of their diminutive modern representatives as Horse-tails and Club-mosses; but even in the distant ages at which their remains culminate in the English Coal Measures, they were as highly organised and as widely divergent as are their reduced descendants at the present day; hence, their origin may be antedated by many geological epochs. Though slight suggestions of attempts at the seed-habit may be traced in some Lycopodiales, and other families of fern-like habit have been more successful in this direction, the true Ferns of the Palæozoic are comparatively few, and they are represented by equally divergent and peculiar forms as Botryopterids and Zygopterids, the anatomy of whose stems affords as pleasing a study as that of Mesozoic

Continued on p.382

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Osmundaceæ. In all such fossil series the marvel grows that these types of vegetation, often so well characterised in xeromorphic organisation, should have been so remarkably constant in general morphology back to remote Palæozoic times, with as little suggestion as to the evolution of their own very special lines as of those of any other type of plant. For the causes that produced them one must go far back beyond the Carboniferous; and while the vegetation of this period is made up of types evidently already relegated to inferior biological stations, as partial aquatics or the vegetation of swamps liable to marine inundations, there is little suggestion as to what may have been the plant-life growing contemporaneously in forest-formation on better ground, of which no trace appears to have been fossilised. The extent to which fossil botany can ever have anything to say on the question of origins receives emphasis, as the appearance of a type in the fossil state clearly affords little clue to either the locus or the time of its initiation, and palæobotanists are still prone to confuse "first appearance" with "evolution." Thus, Dr. Scott writes (p. 370): "A remarkable lacuna in our knowledge of the older fossil Filicales is the entire absence, so far as is yet ascertained, of any satisfactory evidence for the existence of heterosporous forms." Yet in other series the seed-habit, as following on beyond the heterosporous condition, was already well advanced in trees of the Upper Devonian, as well as in Carboniferous Pteridosperms. The period for the first inception of Heterospory must be very remote, as it is difficult to believe that such a significant adaptation to subaerial environment was not contemporaneous in all advancing phyla of Land-flora, and that modern Heterosporous Filicineæ must be a mere relic of the many types that have been, whether these are found in the fossil state or not.

A final section, which is entirely new, will be welcomed by botanists as affording a useful summary of recent publications by Kidston and Lang on the critical types of *Rhynia* and *Hornea*, which have been attributed, without any very clear reasons, to Psilophytales, on the lines of Dawson's older genus of *Psilophyton* (1859). These plants are classed by Dr. Scott with Pteridophyta, on the assumption that the definition of the latter must include any form in which the sporophyte generation is a plant apparently wholly independent of the gametophyte and attached to the soil, however little it may resemble a Pteridophyte in other fundamental features. The plants were growing on peat, presumably formed by their ultimate decomposition, and have been found in the Lower Devonian of Scotland. They are very suggestive of an enlarged moss-habit, only the branches bear spore-capsules, including spore-tetrads, which belong distinctly to the asexual generation. Any light that can be thrown on the vexed question of the extreme dissimilarity of the two generations of the moss life-cycle should be welcome, in view of the fact that the Bryophyta represent the simplest and presumably the most archaic forms of land-flora, and may hence be expected to illustrate more clearly than any other types the biological factors which have led to the successful evolution of land-plants. From the general consideration of the modern representatives of these series, it would appear that the two generations were originally of identical morphological organisation, inheriting a two-phase life-cycle from the higher algæ of the sea; and that while the moss-capsule has been adjusted to the production and dispersal of air-borne spores, its increasing parasitism on the parental gametophyte generation has led to a state of decadence and somatic deterioration as a self-supporting organism, as illustrated in further degree by the smaller and more wholly parasitic capsules of Hepaticæ and Jungermanniæ. That the modern moss-sporogonium is but a relic of a shoot-system which was once branched and probably leafy, with photosynthetic tissues and stomata, bearing spore-producing end-ramuli in the manner of the antheridial ramuli of the leafy moss-plant, may be accepted, in spite of much older academic speculation to the contrary. The general organisation of *Rhynia* and *Hornea* so closely approximates that of such an ideal prototype, in their freely branched rhizome-system with vestigial leaf-points, terminal capsules, and rhizoidal attachment to the peaty soil, that these and associated types bid fair to be the most critically valuable forms of plant described in recent years since the original accounts of *Bennettites* and *Lyginodendron*.

The fact that Dr. Scott, following Kidston and Lang, homologises these peat-plants with the saprophytic *Psilotum* of tropical forests as primitive Pteridophytes, in which progressive sterilisation has not yet given rise to definite leaf-members, and a root-system is not yet invented, as an emendation on the admiration expressed for *Lycopodium Selago* in the "Land Flora" of Professor Bower, admirably illustrates how plastic are the interpretations of such incipient land-flora, and the connection of these ancient lines of moss and fern descent. But it may be pointed out that the discussion of these problems is by no means a question of minor significance to be relegated to the botanical specialist alone. The story of the first evolution of land-plants, even if regarded from no higher an outlook than that of the preparation of the earth's surface for the human race, is one that should interest all representatives of the latter who, in spite of more poetical ways of putting it, are still dependent on subaerial vegetation for their daily bread.

A. H. C.

Elementary Notes on Conifers. By A. H. CHURCH, *Oxford Botanical Memoirs*, No. 8. (Oxford University Press, 2s. net.)

No. 8 of this useful series, issued by the Oxford Botanical Department, comprises a further instalment of Lecture and Laboratory schedules, arranged more particularly for a class of Forestry students, and represents the continuation of a first-year course of botany outlined in preceding memoirs. The schedules are admittedly extremely technical in nature and are full of detail, though abstracted and compressed to a point at which they may be unintelligible to the lay mind without considerable

oral explanation. They are perhaps more interesting as exemplifying what may be not a wholly new departure in university teaching, in which, with the spread of modern textbooks, mere mechanical note-taking has become an anachronism. In such a subject as Botany, however, in which elementary textbooks covering this class of work are scanty, and the phraseology alone is often a deterrent, such schedules giving a minimum of accurate information form an admirable basis for a lecture which may be made interesting to both lecturer and students. The idea is worthy of more extended application. Not only is a considerable amount of information packed away in the two pages of text of some sixty lines each for each schedule, but the collected series affords a good idea of the scope of the subject. The present series contains a fairly detailed account of the organisation of the Scots Pine, in timber, foliage-leaf, and reproductive processes, together with shorter summaries for other types of associated Coniferous forest-trees, as spread over a course of fifteen lectures.

Form-Factors in Coniferæ. By A. H. CHURCH, *Oxford Botanical Memoirs*, No. 9. (Oxford University Press, 2*s.* net.)

No. 9 follows slightly different lines, but is arranged as supplementary to the bare lecture-notes. Attention is drawn more particularly to the value of features of external morphology of the same series of Coniferous trees, from the standpoint of racial organisation and evolutionary progression. The more theoretical relations of genera and species are at the present day largely discussed in terms of the more minute microscopic detail of timber-anatomy, and the cytological specialisation of the reproductive processes and sexual prothallia. It is interesting to find that so much can be made of the more readily observed broader features of the organisation of these plants, as examined in the open rather than in the laboratory, and thus coming within the range of the field-botanist. The expression " form-factor " is utilised to cover features of construction, as opposed to its more technical application in determining the amount of available timber, and includes such subjects as the different phases of dorsiventral habit in lateral branches, the shapes of cones, the mechanism of seed-protection and dispersal, as well as throwing new light on the general theory of the origin of the curious xeromorphic construction known as the " Pine-cone." Final sections include suggestions as to the past history of the genera in geological time, and a useful summary of the distribution and significance of " monstrosities."

The subject is again largely technical, and is written out in an aggressively botanical manner; but to those who will take the trouble to master the somewhat abstruse and condensed phraseology, the pages afford a welcome introduction to some of the more striking problems of the life-history of these few residual survivors of an older epoch of forest-vegetation, and one may begin to take a new and personal interest in such tree-types as living organisms with their own ideals and limitations.

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